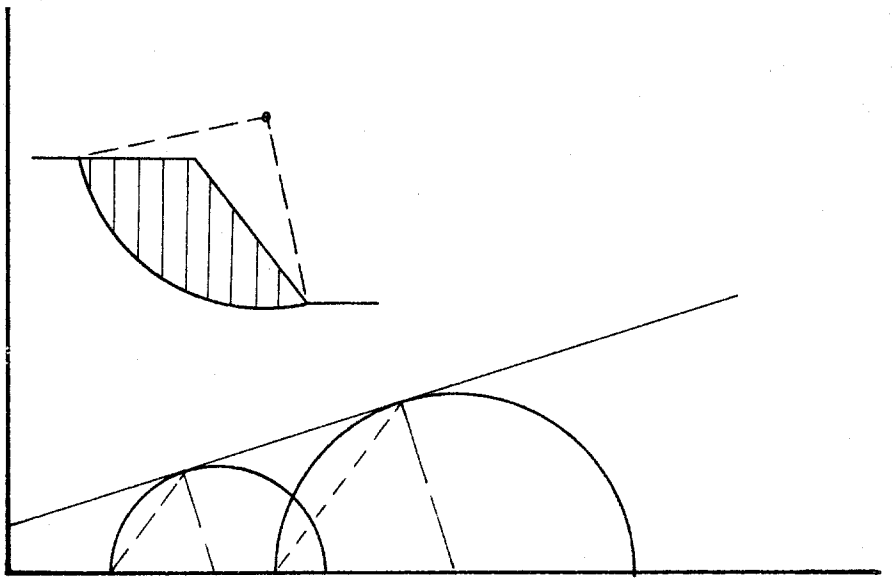
SAND CREEK DRAINAGE STUDY

May, 1968

THE LINCOLN DEVORE TESTING LABORATORY
COLORADO SPRINGS, COLORADO



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Soil Testing

Foundation Evaluation

Materials Tests

Concrete Batch Design

Asphalt Mix Design

Geologic Interpretation

Groundwater Hydrology

by

Registered Professional Engineers

&

Geologists

May 31, 1968

Director of Public Works
City of Colorado Springs
Colorado Springs, Colorado

Dear Sir:

Enclosed herewith is the Engineering Study and Revision of the Sand Creek Flood Drainage Basin authorized by the City Council of the City of Colorado Springs.

The Report includes a study of the rainfall runoff characteristics and the channel improvements for the entire basin. It also includes a restudy of storm sewer requirements, hydrographs and existing and required streets and grading in the basin.

The study may be used as a master drainage plan for the basin as it completes development in the near future.

Respectfully submitted,

LINCOLN-DeVORE TESTING LAB.

George D. Morris, P. E.

/jb

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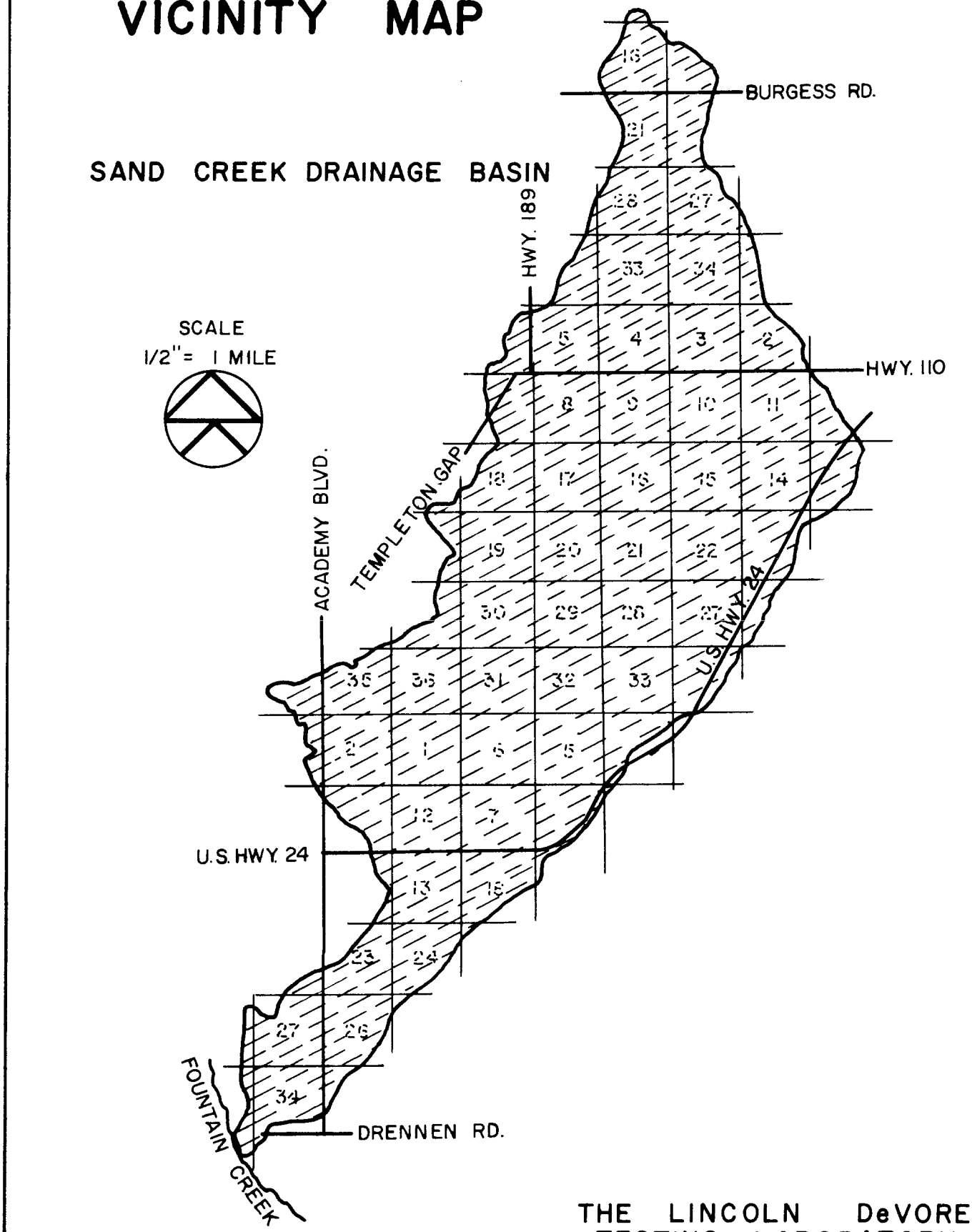
VICINITY MAP



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SCOPE AND PURPOSE OF STUDY:

This report is intended to furnish the basis for an overall plan for placing storm sewers and other drainage appurtenances in the Sand Creek Drainage Basin in the near future. The original study of this basin was done in January of 1962 by United Western Engineers under the direction of George D. Morris, P. E. At that time nearly all of the basin was undeveloped and the storm sewers were proposed for projected subdivisions in the area. As the basin developed it was found that the subdivisions did not entirely develop as anticipated and that, therefore, the drainage requirements were changed to some extent.

In addition to this, criteria for the study of drainage basins has been changed and these changes must be reflected in the restudy. The greatest change in criteria was that involving the use of small storage retention reservoirs in the original study. These have been eliminated by the direction of the Colorado Springs Drainage Board and the revision of the greenbelt width and depth requirements is therefore necessary. Another revision is the paving of all small concrete ditches with either concrete, riprap, or asphalt and the paving of large sections of the greenbelts themselves.

The intent of this restudy is not to establish the precise design of the storm sewer or channel in

any particular area. It should rather establish the general location of required storm drainage structures and their general required sizes. It will establish those natural channels which will remain as water carrying channels or greenbelts and those which may be eliminated. It will also establish the size of major structures along the greenbelts. It will be noted that certain of the storm sewer appurtenances noted as "storm sewers" on this proposed plan have been taken care of by the construction of small ditches. In highly developed areas, these ditches are not desirable, particularly in the front lot lines and the storm sewer would be preferable for eliminating runoff. However, the ditches do exist and for the most part, are adequately handling the rainfall runoff at the present time. For this reason it may be that the storm sewer as proposed will not be constructed but the ditch will be left in place and used.

At the present time the area included in the lower Sand Creek Drainage Basin is about 1/3 completed as far as subdivision design is concerned. The locations of storm sewers and drainage appurtenances can be closely established in these areas. In the eastern portion of the basin, however, the street plan is not as yet known and any study of this type must be necessarily general until the precise location

of the streets is established. Some changes will be noted between this revised drainage plan and the original study. These changes have mostly been brought about by what is now known of the area development and by existing bridges, ditches and other appurtenances which have been constructed or definitely proposed. Although a large portion of the basis in still undeveloped, the usage of the area is almost completely known at this time and more accurate rainfall runoff criteria can be established for the area.

Fortunately, by use of the original drainage study of the area the major drainage channels have been saved and are available for use at the present time. In some cases the sizes of these channels should be increased. Bridges which were built across these channels in anticipation of storage reservoirs must also be increased in size. In that portion of the basin in which no plan presently exists, streets have been located in positions which will facilitate the removal of storm water. If these streets are not constructed as shown, then the possibility exists of greater amounts of storm sewer requirements.

As the basin has developed it has become impossible to use as many small ditches as were originally proposed. It was noted in the original report that ditches are usually more economical than underground pipe, and therefore, somewhat preferable. The revision indicates the use of many

ditches at various points on the subdivisions where it is practical. It has, however, become impractical to use ditches in some develped areas. Therefore, underground storm sewage works are more extensive on this second plan than on the first. This is true particularly on the west and northwestern portions of the lower Sand Creek Basin.

All of the studies of undeveloped basins which the City has commissioned have provided the basis of a logical overall storm drainage plan prior to the time of general subdivision development. It was noted in redoing the Sand Creek Drainage Basin that this plan has been a help in the area mainly in maintaining existing channels and rights of way. This is particularly true in the "Rustic Hills" area north of Highway 24. It is felt that the drainage plans have been useful since major construction problems caused by the existance of streets or structures over drainage areas have been generally avoided.

BASIN DESCRIPTION:

The Sand Creek Drainage Basin contains approximately 52 square miles and lies generally east and northeast of the City of Colorado Springs. It extends from Austin's Bluffs on the west to the Town of Falcon on the east and from Vollmer Road in the Black Forest area on the north to

a point on Fountain Creek near the boundary of Fort Carson on the south.

The entire basin is drained by Sand Creek which has four major branches and several minor ones. Water can be found in the main stream and in some of the branches during years of high rainfall. Generally, however, the entire streambed is dry or nearly so. Test borings made in the area indicate that a substantial subflow is existing under the stream bed through the deep sand alluvium. The surface of the stream bed, however, is usually dry.

The records indicate some very high flows in past years and these flows have left their mark in eroded banks and sand deposits. The local storm of two years ago caused most of the branches of Sand Creek to run at a very high water level for a short period of time. A great deal of damage was sustained in certain areas. Most of the damage occurred at locations at which the drainage structures had not been completed. Evidence of considerable erosion can be found along the entire reach of the stream and in most of its branches. A large amount of soil conservation work has been done in the upper and middle basin, and consequently, high flows of water have been infrequent in recent years.

The basin has a rolling topography with a small area of abrupt hills or bluffs. The valley is relatively narrow through the northern third, widens out at the middle third, and narrows again in the southern third. Most of the creek channel is wide and flat indicating relatively slow water movement even during flood flow.

For convenience in using the maps of the area, it has been divided into several sub-basins most of which are drained by a single major stream. Sand Creek is a mature stream and as a result has numerous small branches and a very wide floor plain at most points. For this reason it is somewhat difficult to describe specific areas by stream branches.

GEOLOGIC FORMATIONS, SOILS & WATER TABLE:

Four geologic formations are found within the basin. Added to this are various alluvial formations which are actually combinations of the residual formations which are found. These include, in general, four soil types. Since a large amount of the area consists of miscellaneous alluvial and windblown formations, these soil types may not be obvious on the surface of the ground. They do exist a short distance beneath the ground surface, however, and must be used in

computing runoff factors.

The northern portion of the basin is all of the Dawson Formation which is primarily sands, sandstones, and clayey sands. It is in this formation that the high, abrupt bluffs are found near the west-central portion of the basin. The Dawson Formation is a very erratic formation ranging from sandstones to high plastic clays. For this reason, the hydrologic runoff factor is somewhat difficult to determine. The runoff factor was determined from previous test borings in the areas and from a study of the aerial photographs of the formations in the area. Both the sandstones and the clays have relatively high runoff factors while the sands and talus slopes alluvial sands of the Dawson have a low runoff factor. This has been taken into account in the northern portion of the basin.

The central portion of the basin is composed primarily of the Laramie and Fox Hills Formations. Both formations are quite similar as far as hydrologic runoff factors are concerned - with one exception. The Fox Hills Formation contains more clayey materials, is more easily saturated, and the runoff can be very high if rainfall lasts for an extended time. For a short term storm both soil types are quite similar. The hydrologic data used in this report

considered the soils to be at a "normal" saturation point at the time of the design storm. Using this criteria, the difference between the two storms is very small. Both formations consist of silty sands and some clay shales. The surface of the ground in this area is covered by considerable amounts of local alluvium transported to the site by various branches of Sand Creek. Some loess and sand dunes are also found in the area. These affect drainage characteristics to some extent, but in general, their area is quite small. In the vicinity of Highway 24, some of the Fox Hills clays can be found on the surface of the ground. These are covered to a great extent by alluvium, however, and their action on the runoff characteristics in the area is not great.

About 1/2 mile south of Highway 24, the fourth and last soil type is found. This is the Pierre Shale Formation usually covered by a thin layer of either windblown or alluvial sand. This shale does not allow infiltration to any great extent and runoff is quite high. The Pierre Shale does not extend across the entire basin at the surface at any point, except at the south end, mainly because the ridges at both west and east sides of the basin are covered with windblown sands. The Pierre Shale is quite common south of Airport Road, however, and can be considered the

predominate soil type in the area.

Except in the stream beds proper there is no consistant water table in this basin at any depth. Certain marshy areas do exist, particularly near Airport Road and north of Highway 24 along the western branches of Sand Creek. These areas are marshy due to relatively flat grade and the shale of either Fox Hills or Pierre origin being quite near the surface of the ground.

RAINFALL & RUNOFF PATTERNS:

Annual average rainfall in the Sand Creek Basin is low being about 14-1/2 inches per year. However, the major portions of this rainfall occur in May, June, July and August. Both mountain type storms and plains type storms fall on this basin, due to the proximity of the mountains. Storms of record in the basin fall into two general categories:

(1) Short, intense storms lasting up to 2 hours and usually rather local in nature, and

(2) Long term storms lasting 6 hours or more and spread over a large area.

Long term storms last a longer period of time and allow high infiltration. This produces a large total volume of runoff, but a relatively low period of flood peak due to the period of time involved. Short duration storms produce less total runoff, but being quite intense, have a high flood peak developing rapidly through the basin. With subdivision

development in the area, the peak becomes higher and the runoff time becomes shorter. The original basin report investigated four storm types. They were:

(1) 30 minute duration, .8 intensity, 2 year frequency storm
(2) 1 hour duration, 2 inch intensity, 50 year frequency storm
(3) 6 hour duration, .75 inch intensity, 25 year frequency storm
(4) 6 hour duration, 3 inch intensity, 50 year frequency storm

The initial investigation indicated that the 1 hour duration, 2 inch intensity, 50 year frequency storm would produce the highest flood peak. This criteria was checked in the second investigation on the basin and was found to be correct. The 50 year, 1 hour storm was confirmed for use in design. For the purpose of this report, therefore, all data given is for this particular design storm.

50 year frequency rate mentioned above is misleading in some ways. It is true that a storm of this intensity can be expected to cover the entire area of the basin approximately every 50 years. It is also true, however, that a storm of this intensity may be expected on a local basis about every 3 years. For design purposes, therefore, it is not safe to consider any storm of lesser rainstorm than the one used in this report. It should be noted, particularly in this basin, Sand Creek has many small branches. These branches must be taken as individual units with the subdivision drainage.

Except for the very far south end of the basin, therefore, the so-called 50 year frequency storm must be expected on a local basis much more frequently, probably about a 10 year cycle. A small, local storm might affect one entire branch of Sand Creek without affecting any of the others on an average of about once every 10 years.

No measured runoff data exists for this basin other than observations which have been taken at various points in the last 5 to 6 years. These observations indicate that the design flood peaks will be approximately correct for the 50 year storm of the type anticipated. Observations of the damage which occurred in the 1965, 1966, and 1967 seasons were used to compute water flows at various points. This is not always an accurate method of obtaining such flows but is the best record available at this time. Observations of runoff of this type were added to various data which was collected from Soil Conservation Service, the Forest Service, the Weather Bureau, and Bureau of Reclamation records. This data was then adapted to the Sand Creek Basin by use of the system developed by the Soil Conservation Service and revised by the U.S. Bureau of Reclamation.

It should be noted that in one important respect, the proposed land use of the basin has changed rather drastically from the original thinking of drainage

investigations. Originally, most of the far eastern portion of the basin was assumed to develop into half acre or larger tracts. It should be noted that almost all of the subdivisions which have, in fact, been placed in this area are of smaller lot size and approximate city subdivisional lot sizes. It is felt that this fact will cause slightly higher runoff factors and, therefore, higher flood peaks. Also it should be noted that the runoff is allowed to move more rapidly through the developed greenbelt systems than was originally anticipated. The original thinking of the greenbelt was to spread the water over a wide area, thus slowing down the flood peak and, in effect, lowering the peak. In actual practice the greenbelt has been narrowed by economic considerations to the point to where velocities are 2 to 3 cfs faster than originally anticipated. This has caused higher flood peaks in the area which must be accounted for by somewhat larger structures and deeper ditches. The removal of the proposed retention reservoirs has also allowed a faster runoff which also implies larger greenbelts. To some extent this has been offset by the larger number of streets which have been placed in the subdivided areas.

All of the hydrographs developed in this report are based on the assumption that the entire area

will develop as it is now developing. The basin is divided into 138 sub-basins as given on the attached drawings. An outfall point was assigned to each sub-basin and a synthetic hydrograph was constructed for these points. Due to the absence of measured data, the available data from the Soil Conservation Service must be used together with such observations as are available.

The final hydrographs of each minor basin are routed on a time scale so that a combined hydrograph could be constructed at various points on the greenbelt system. The combination hydrograph gives a graphical picture of the flow down Sand Creek and its various tributaries. A large number of these combined points have been taken along Sand Creek Basin due to the fact that the creek has so many fairly large tributaries. Since it takes a certain amount of time for a flood crest to travel from point to point and since the length of the various tributaries is relatively long, it was found that the peak of the combined hydrographs gradually increases in time interval as the crest moves to the southwest. The pattern of flow shown in the report is somewhat different than shown in the original report due to the various changes previously mentioned. The basin, however, is so large that these changes are relatively small.

It should be noted that the crest of the hydrograph becomes sufficiently large to become a flood hazard by the time the crest reaches the Rock Island Railroad track on the east branch and on the central branch. The flood hazard of the west branch does not become critical until the branch crosses Galley Road. From these points on toward the south the flood crest can be destructive at any time it is allowed to leave the greenbelt. The flood crest, of course, can be destructive above these points but on a fairly localized basis.

As in the original investigation for this basin, the Sand Creek basin has been divided into two sections - the southern portion and the northern portion. The northern portion of the basin is considered to be too far from the city to be developable within the next 20 years on any large scale basis. No storm sewers or other drainage appurtenances were designed for this area, although the storm flow was computed, routed, and greenbelts were sized through the area. Since some development is very likely in the area prior to the time it is taken into the City, it was assumed that this area will developed into tracts of 1/2 Acre to 1 Acre in size. The runoff in the northern portion of the basin has been computed from this assumption. The division between the northern and southern portions of Sand Creek has been taken

along the northern boundary of sub-basins 83, 93, 94, 38, 37, 36, and 34. South of this line all of the area was assumed to develop in city type development which will probably be complete by the next 20 years. South of this line, drainage structures and appurtenances were shown on the proposed map of the area together with all greenbelt improvements.

PREVIOUS DRAINAGE WORK IN THE BASIN:

None of the reservoirs proposed in the original report have been constructed in the basin. In those areas which are now being used for agriculture and grazing a large number of stock ponds and miscellaneous drainage control structures are located. These, however, will be removed when the development reaches them. Any aid which they might give toward reducing the size of the flood peak or lengthening the time of flow will be gone as soon as the area is developed. These were, therefore, not considered in this revision of the basin report.

In the western portion of the developed area of the basin, a great many of the bridges and other drainage structures have been constructed over the past six years. These include several bridges along the west branch of Sand Creek and the west-central branch of Sand Creek. Some development has taken place along Highway 24 by the State Highway

Department. At least one major bridge has been constructed along the east branch of Sand Creek along Highway 24. The original bridge was of considerably greater capacity than required. This bridge has no effect upon the flow of the east branch other than certain scouring characteristics which will take place around the pilings. Some of the bridges which have been built are adequate to control the proposed drainage and some are not. Many of the bridges, particularly along the west branch of Sand Creek, were constructed with the assumption that a storage retention reservoir would be built above them. Since this was not done, these bridges must be enlarged to handle the higher flow. This is true of several other structures which have been placed along the main green belt. The most practical method of enlarging these bridges would not be to tear out the structure and replace it, but to add a box or pipe to each side of the existing structure. In effect, the existing structure would then be lengthened.

Some portions of the proposed storm sewers in the original Sand Creek report have been constructed. These have been constructed almost uniformly throughout the basin as ditches rather than underground storm sewers. This is particularly true in the developing western portion of the central Sand Creek and in the Pikes Peak Park area. Very little underground work has been accomplished in the Rustic

Hills portion of the drainage basin with almost all of the water handled by street drainage and ditch flow. Since these subdivisions are now constructed, it will be very difficult to replace the existing ditches with storm sewers. In some cases, however, this should be done eventually to reduce the possibility of localized flooding. Therefore, the storm sewers have been shown on the proposed development plan with the notation that they are not at present in place.

MAIN CHANNELS - GREENBELTS:

All previous studies commissioned by the City of Colorado Springs recommended a greenbelt drainage system in the area. This is desirable and is generally the most economical method of removing flood runoff from any developed area. The cost of open ditches or drainage channels is almost always lower than that of pipes and ditches are usually easier to maintain than an underground pipe.

In this particular basin nearly all of the subdivisions since 1962 have been planned with regard to the greenbelt and have assumed that the greenbelt is in existance. Most of the plats filed in the area have platted the greenbelt. For this reason, nearly the entire length of the west branch and west-central branch of Sand Creek is in existance, at least legally, and is available for use. In some places, it is

somewhat narrower than desired. Any further subdivisions in contact with the greenbelts should also include the proper areas for the greenbelt channels.

It will be found upon examination of the accompanying maps that all of the greenbelts have been designed to follow the natural streambed and in general do not interfere with land suitable for subdividing. Required channel widths and depths are shown on the maps and in the appendix, but in general, the channel design should be such that the channel will be as wide as possible and relatively shallow water draft. This will reduce the velocity in the channel to an amount which will at least partially control scour. This also reduces the danger to people living in the area and reduces the amount of required channel stabilization. In the areas of narrower greenbelts, however, the velocities are considerably higher. It is therefore felt that the channel must be stabilized with either riprap or concrete sides and a soil bottom. Over most of this area the soil will resist scour to some extent until the velocities become greater than 9 or 10 cfs. It is felt that the bottoms of most of the channels may be left as dirt, or possibly, grass bottom without unnecessary danger. In the narrow greenbelts the bottom of the channel will of necessity be stabilized by either a check dam system

or by complete paving.

Junctions of the greenbelts and bridge locations must be completely paved to prevent scour. These various areas are noted on the plan and in the appendix. For the most part they consist of a greenbelt ditch of Type III.

It should be noted that several of the structures now existing across the greenbelts will tend to impede the flow and cause the greenbelt to act as a storage reservoir for a short time. Since the abandonment of the storage reservoir concept, these structures must be increased in size to accomodate the entire flow and not impede it. In order that the channel may not be blocked and the flow not impeded at any point, it is felt that the greenbelts should be controlled by the City of Colorado Springs and not allowed to exist merely as easements across the rear of lots. If this cannot be done, then the ordinance should specifically restrict the building of chain link or other structural types of fences across the channels.

INDIVIDUAL IMPROVEMENTS:

Attention is directed to that portion of the appendix which lists individual improvements to be recommended in this basin. These lists of ditches, storm sewers, and

bridges together with the map of the basins show recommended improvements to much greater advantage than any discussion.

After designing the main channel and individual ditches, each individual basin was studied using the minor basin hydrographs previously described. Water flow at various points in each basin was compared to street capacity and distribution. The street capacity used was in accordance with the latest City chart of usable street capacity. In some cases it was found that the specification of certain sized streets would be sufficient to distribute runoff properly and in other cases, this will probably not be sufficient and storm sewers or ditches will be required. These are the drainage structures which are shown on the attached lists and maps.

By judiciously spreading the drainage among several streets, this particular basin can lend itself to the control of runoff with street design. In some cases, however, this is not possible, particularly in the hilly portions of the subdivision. Some flood water may be spread through a street system as has been done in Eastborough, Cimarron, and portions of Rustic Hills. In general, however, major streets were found to tend toward the greenbelts collecting water on the way. This almost invariably leads to the overloading of the collector street. The City requirements on street drainage do not allow this quantity of water on major streets and storm

sewers will be required on a large number of them. As previously noted, some of these storm sewers will probably not be constructed in the near future since the subdivision is already in and the streets are paved. However, eventually the flood conditions on these streets will cause the storm sewers to become required. It is recommended that in those streets which are not yet built these storm sewers be placed prior to construction. This would take care of the drainage in a more adequate manner and would be more economical in the long run.

Particularly in the eastern and southern portions of the basin, certain streets have been located by the engineer in this report. The location of these streets was dictated almost solely from the drainage standpoint. In general, these streets are designed to be collector streets leading to greenbelt systems. If the final plat of the area can effectively spread the water through a large number of streets, then some of the storm sewers shown in these areas may be abandoned. The topography of the ground does not indicate that this is possible, however. The locations of these streets as shown do not necessarily have to be followed but would certainly be best for drainage purposes. At nearly every connection with a street and a greenbelt, dropout structure has been noted on the plan. This

consists for the most part of a concrete structure carrying water directly from the street into the ditch, or possibly, directly into a greenbelt. These dropout structures must be individually designed for the condition which prevails at each points. A generalized standard has been included in this report for use at any of these inlet or outlet structures. It must be pointed out that they may not fit specific conditions, however.

Inlet problems are very difficult, particularly in the case of streets with steep grades. Such problems must be worked out for the areas designed since individual street design will alter the inlet design somewhat.

Curb inlets in general do not allow a great deal of water to flow into a storm collection system. The City of Colorado Springs standard curb inlet can only be assigned an intake value of about 8 cfs per opening. This value itself may be somewhat high. Specially designed intakes will therefore be advantageous at several places in the basin. High capacity intakes shown in the appendix, for example will allow a total of nearly 48 cfs to enter the storm sewer system. This is roughly the equivalent of six standard City street design openings. Even though construction o f the high capacity inlet is more complicated and somewhat more expensive, it would prove more advantageous in many places.

Throughout the basin, the water which is being carried in the streets is generally being directed to the greenbelt through small ditches. This has been incorporated into the study as a general basin design. Pipe culverts could be substituted for the ditches if desired, but are generally more expensive and do not carry the water as well in short distances. Inlet problems are also considerably magnified with pipe culverts. These ditches are designed uniformly for concrete lining. This may not always be absolutely necessary but is recommended for the purpose of ease of maintenance in these small open ditches.

SPECIFIC PROBLEM AREAS:

Most of the problem areas noted in this basin are concerned with the crossing of the various Sand Creek tributaries by a major road or state highway. In many cases, the bridge structure or culvert which has been placed at these crossings is not adequate by considerable amount to carry the water which will flow down this tributary. All such inadequate bridges or culverts should be replaced or enlarged to carry the flow more uniformly.

Particularly along the west branch of Sand Creek in the Rustic Hills area, the bridges which were designed were designed contemplating an upstream retention

reservoir. These bridges are all too small to contain the flow without a reservoir and should be enlarged. At three locations in this same area, storm sewers should be placed in the streets. These streets are already paved and constructed. At the moment they are carrying such storm water as exists. However, with the larger storm and greater development in the area these streets will be overloaded and the storm sewers should be constructed.

At two points along Highway 24, the crossing of the west branch of Sand Creek and the crossing of the central branch of Sand Creek, the culverts are too small. These should be enlarged in both cases by the Department of Highways.

All the stream crossings on Airport Road, Fountain Boulevard, and Academy Boulevard are small pipe culverts and are hoplessly inadequate for the flow which will cross at these points. The flow at these points is sufficiently large to justify the construction of a bridge or large concrete culvert rather than a group of small pipe culverts. Pipe culverts can be used, however, if they are properly sized and placed. The streambed is quite wide at the crossings of these three streets and if the drainage structures are not enlarged to the recommended sizes, a certain amount of water back-up will occur at each street causing either flooding of adjoining

property or eventual destruction of the streets.

The experience of the middle 1960's has proven that several of the bridges and storm sewers shown on the proposal are desperately needed. The storm sewer and ditch system in the Rustic Hills area is now being completed and will probably be adequate as designed with the exception of the bridges previously mentioned. The greenbelt crossing at Constitution near Academy Boulevard is inadequate for both water and traffic and should be redesigned. One example of the nonexistant storm sewer being desperately needed is that shown up Wooten Drive and Fetterman Street in Rustic Hills. These two areas were badly flooded by a very localized small storm with the result that the street system was incapable of carrying the amount of storm water which was generated. To date the damage has been relatively small. However, large areas above these streets are now being proposed for paving, commercial use, and residential use. As this occurs, the amount of runoff will be higher as reflected in the figures of this report and the storm sewers will become badly needed.

SUMMARY & RECOMMENDATIONS:

Experience in the City of Colorado Springs has shown the futility of trying to controll runoff with street drainage alone. Streets will carry large quantities

of water under favorable conditions but cannot carry the high flood peaks which are common to the local intense storms of the area. The specifications of the City of Colorado Springs indicate that water is not desired in the streets, particularly arterial streets, increasing the original problem of carrying the water in streets.

The use of streets as drainage flow structures can be tolerated up to a point. It is therefore recommended that all streets be used as drainage ways insofar as possible under the City regulations. There is a point, however, at which the street is simply unable to carry the water and traffic at the same time. At this point a storm drainage facility must be designed. For this purpose, the greenbelts and storm sewers have been recommended in this report.

The specific recommendations in this report are mostly shown in the appendix and on the attached maps. The greenbelt widths are specified along with ditch sizes and storm sewer sizes in general. Some caution must be used in applying these sizes in undeveloped basins since the new streets in the basins will affect the size and location of the proposed appurtenance.

An additional recommendation would be to increase the size of certain major structures over the existing greenbelts. This increase in size can be accomplished

by the construction of extra boxes or pipes on each end of the existing structure thereby lengthening the effective structure but not going to the expense of removing the entire structure. These sizes are shown on the maps and attached appendix.

Due to the removal of the formerly proposed reservoirs from the Sand Creek plan, it is recommended that the greenbelt widths be widened to some extent, that the sides of the greenbelt ditches be either riprapped or concrete lined, and that all local ditches be fully lined with concrete.

Specific portions of the greenbelt are recommended to be completely lined with concrete both sides and bottom at points where heavy scour is expected. Other points of the greenbelt can be left as dirt bottom or grass bottom since the velocities are low and turbulence is much less. In some places, the concrete bottoms of the greenbelt can be replaced by a check dam system which will reduce the velocity of the water.

The general recommendation of this study is that the design features shown in the appendices and on the maps be followed in general terms.

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LEGEND

- DRAINAGE BASIN BOUNDARY
- MAJOR SUB-BASIN BOUNDARY
- MINOR SUB-BASIN BOUNDARY
- VII MAJOR COLLECTION POINT
- EXISTING ROADWAY
- PROPOSED ROADWAY
- EXISTING CULVERT
- EXISTING BRIDGE

SAND CREEK

DRAINAGE STUDY

FOR THE

CITY OF COLORADO SPRINGS

REVISED MAY 1968

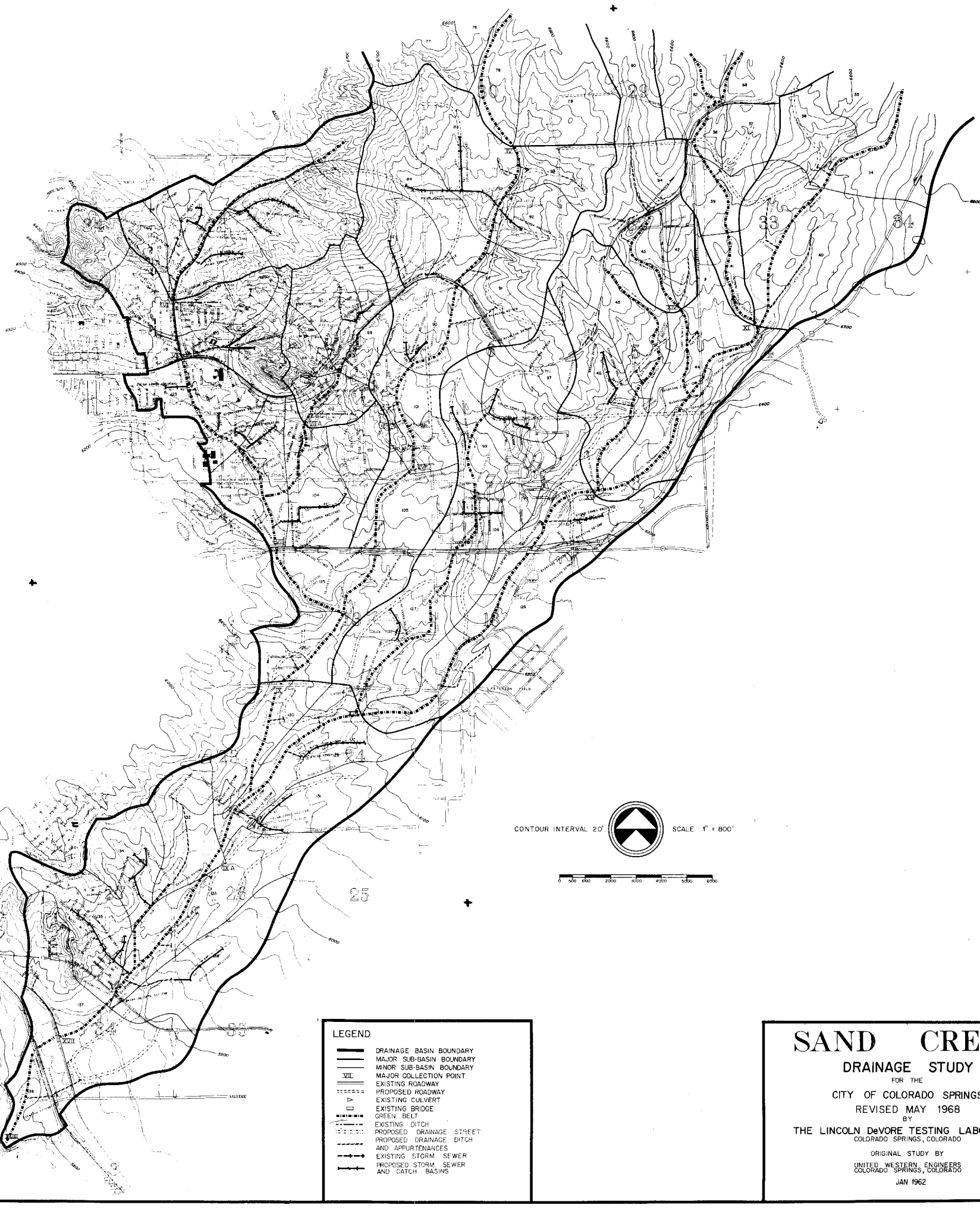
BY

THE LINCOLN DeVORE TESTING LABORATORY
COLORADO SPRINGS, COLORADO

ORIGINAL STUDY BY

UNITED WESTERN ENGINEERS
COLORADO SPRINGS, COLORADO

JAN 1962



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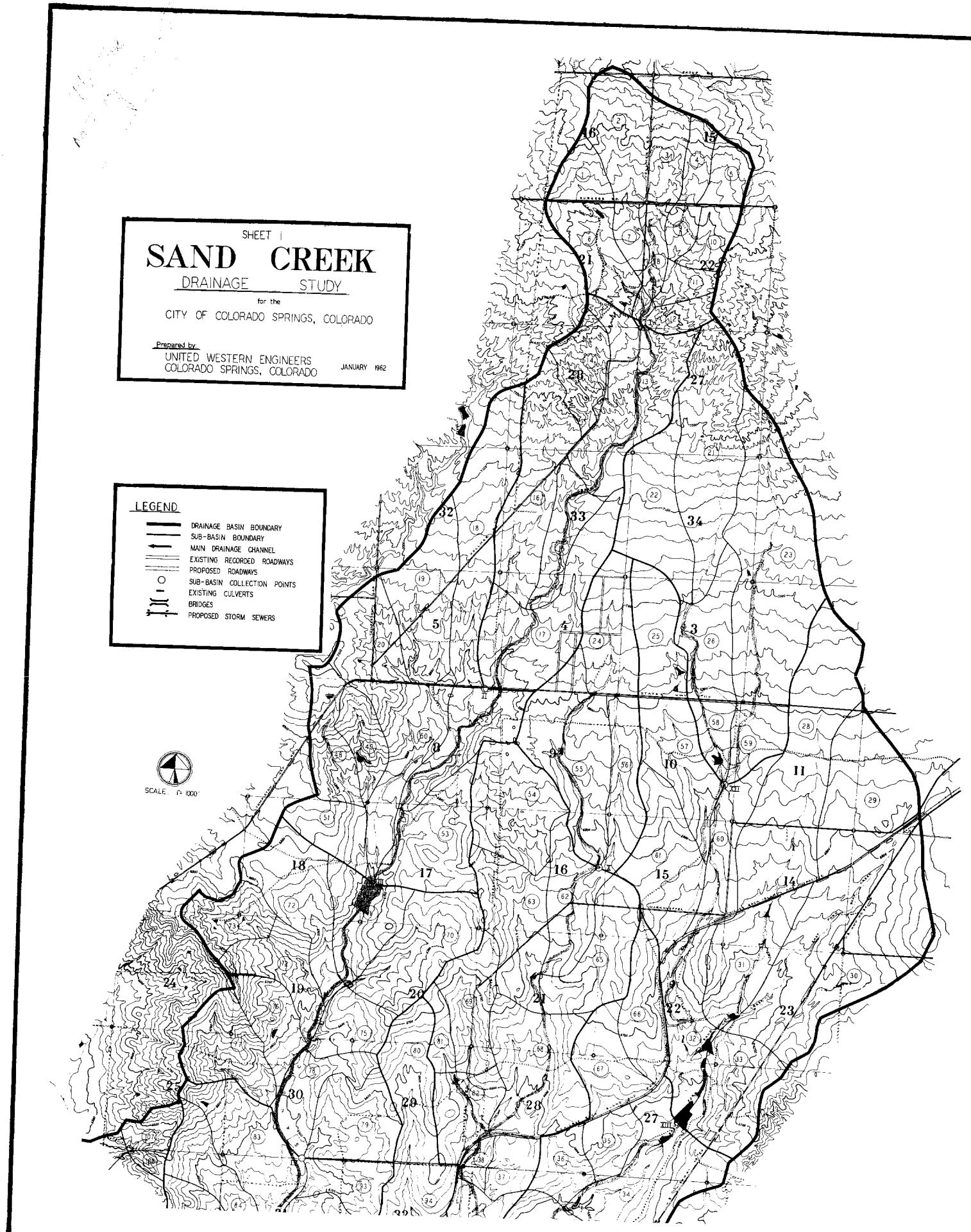
SHEET I
SAND CREEK
DRAINAGE STUDY
for the
CITY OF COLORADO SPRINGS, COLORADO
Prepared by
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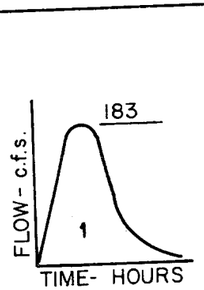
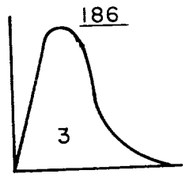
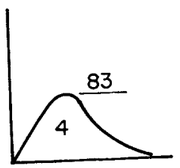
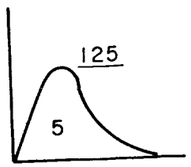
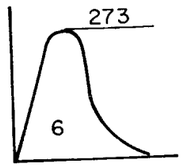
COLORADO SPRINGS, COLORADO
JANUARY 1962
LEGEND
DRAINAGE BASIN BOUNDARY
SUB-BASIN BOUNDARY
MAIN DRAINAGE CHANNEL
EXISTING RECORDED ROADWAYS
PROPOSED ROADWAYS
SUB-BASIN COLLECTION POINTS
EXISTING CULVERTS
BRIDGES
PROPOSED STORM SEWERS
SCALE 1" = 1000'

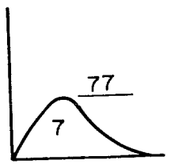


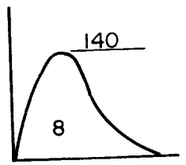


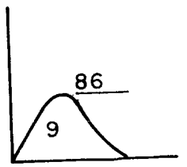


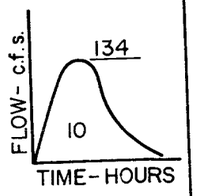


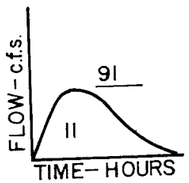


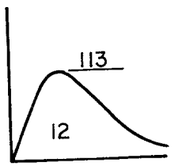


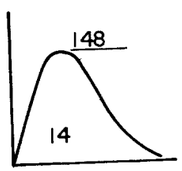


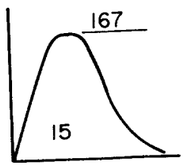


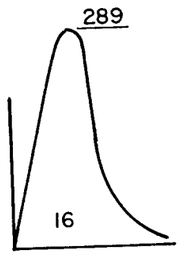


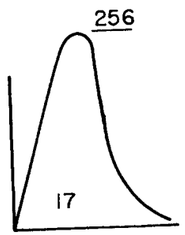


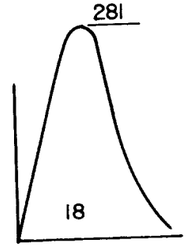


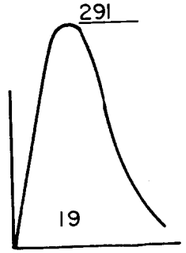


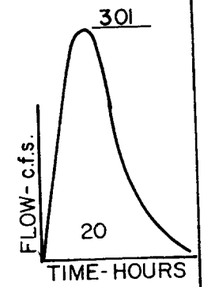


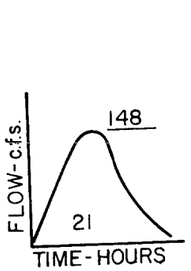


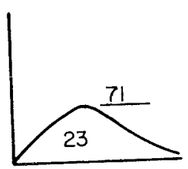


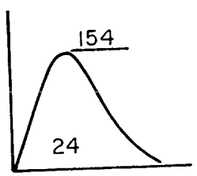


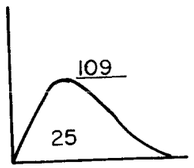


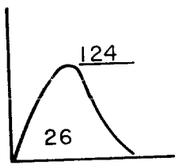


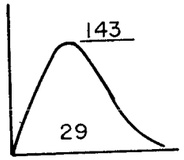


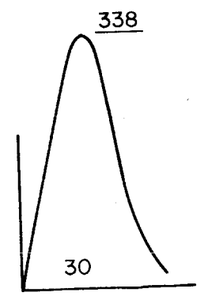


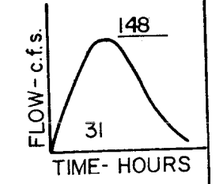


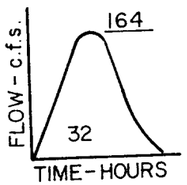


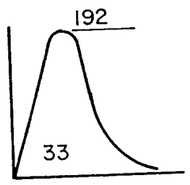


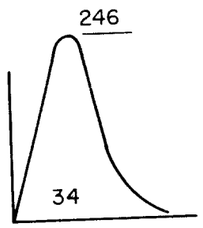


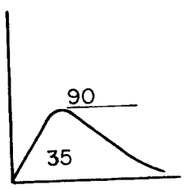


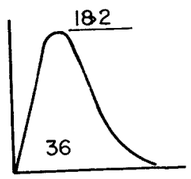


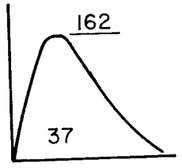


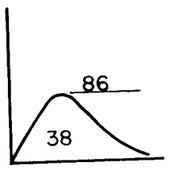


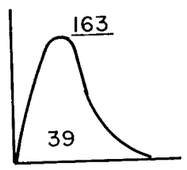


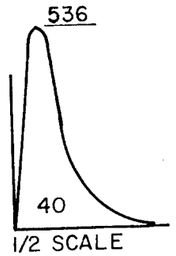


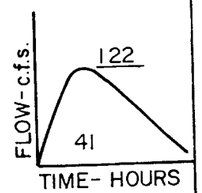








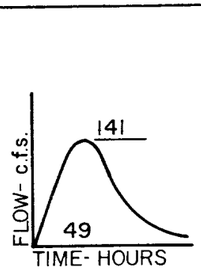


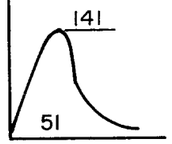


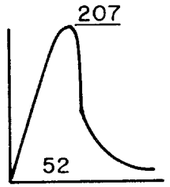
HORIZONTAL SCALE 1" = 2 HOURS

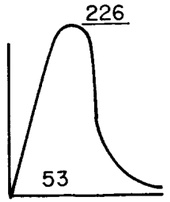
INDIVIDUAL SUB-BASIN HYDROGRAPHS
SAND CREEK DRAINAGE BASIN
CITY OF COLORADO SPRINGS

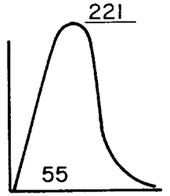
THE LINCOLN DeVORE
TESTING LABORATORY

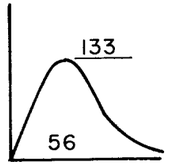


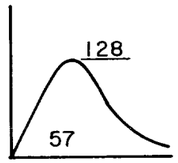


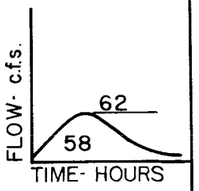


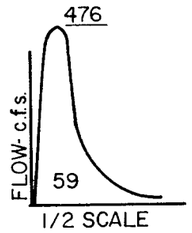


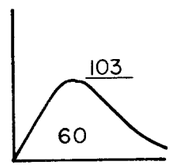


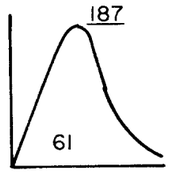


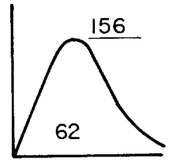


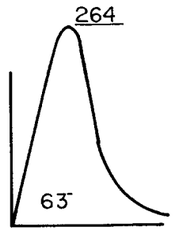


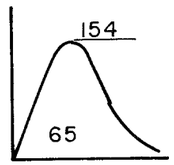


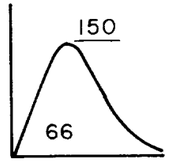


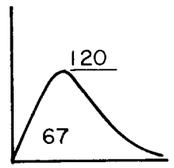


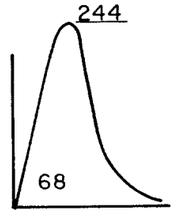


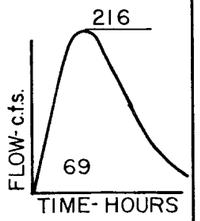


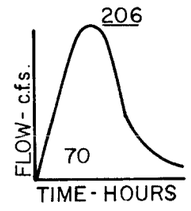


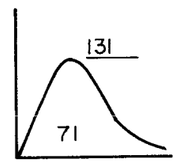


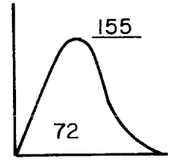


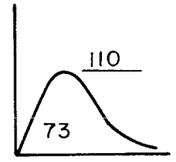


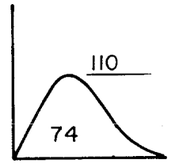


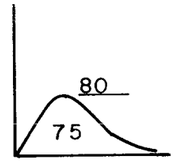


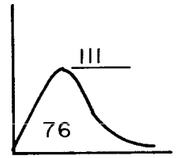


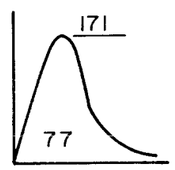


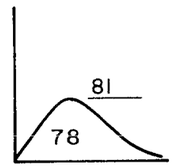


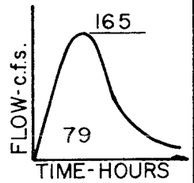


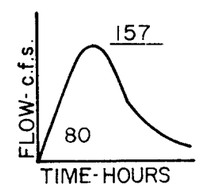


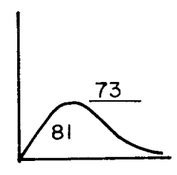


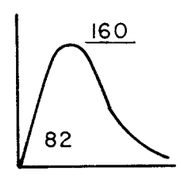


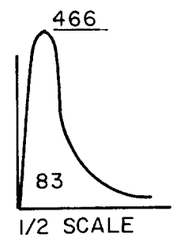


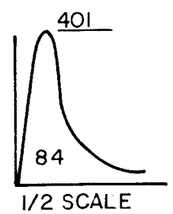


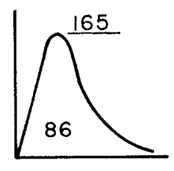


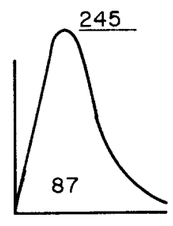


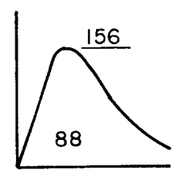


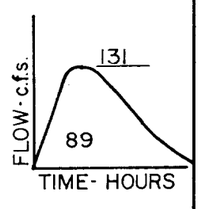








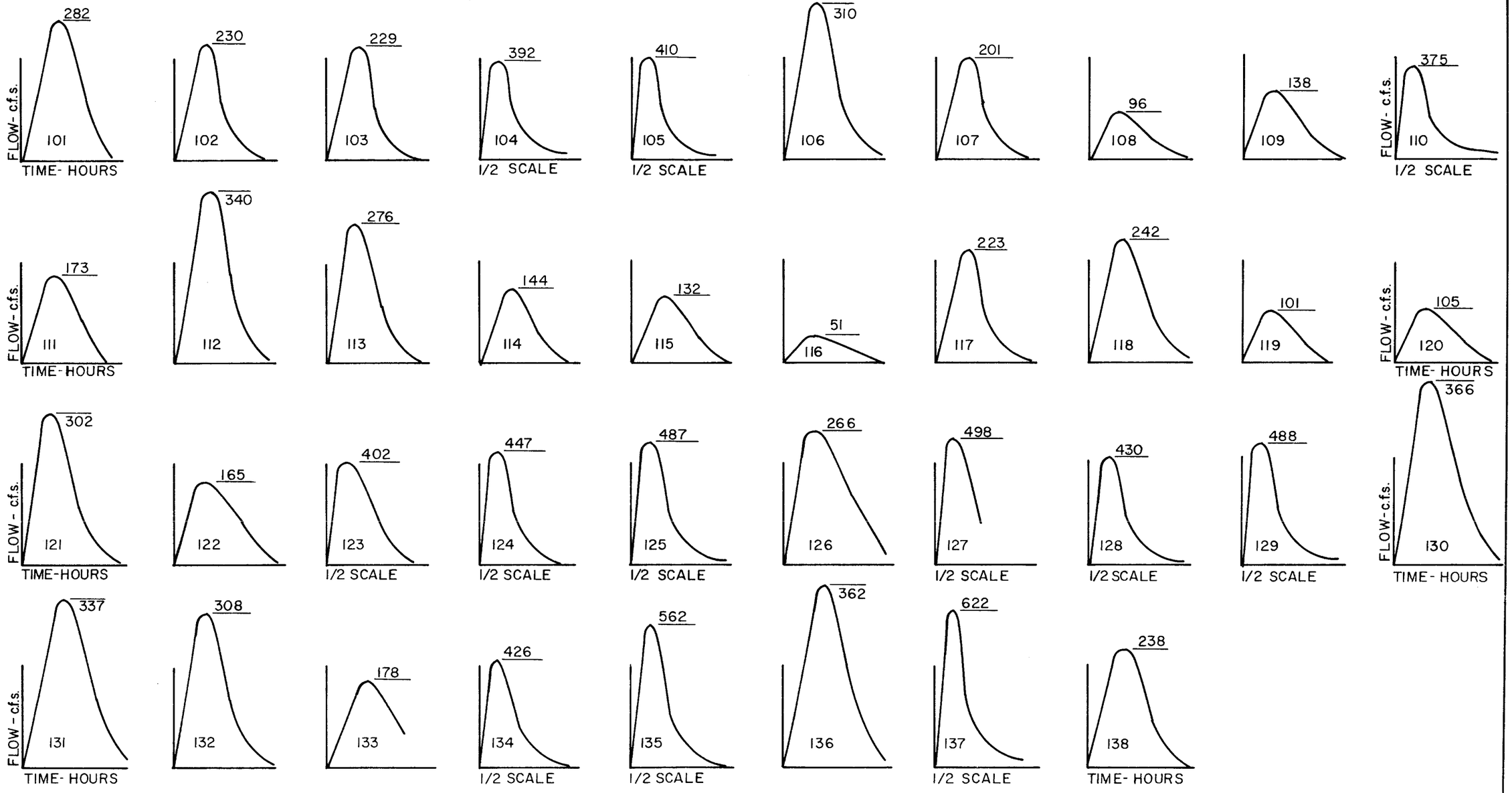




HORIZONTAL SCALE 1" = 2 HOURS

INDIVIDUAL SUB-BASIN HYDROGRAPHS
SAND CREEK DRAINAGE BASIN
CITY OF COLORADO SPRINGS

THE LINCOLN DeVORE
TESTING LABORATORY

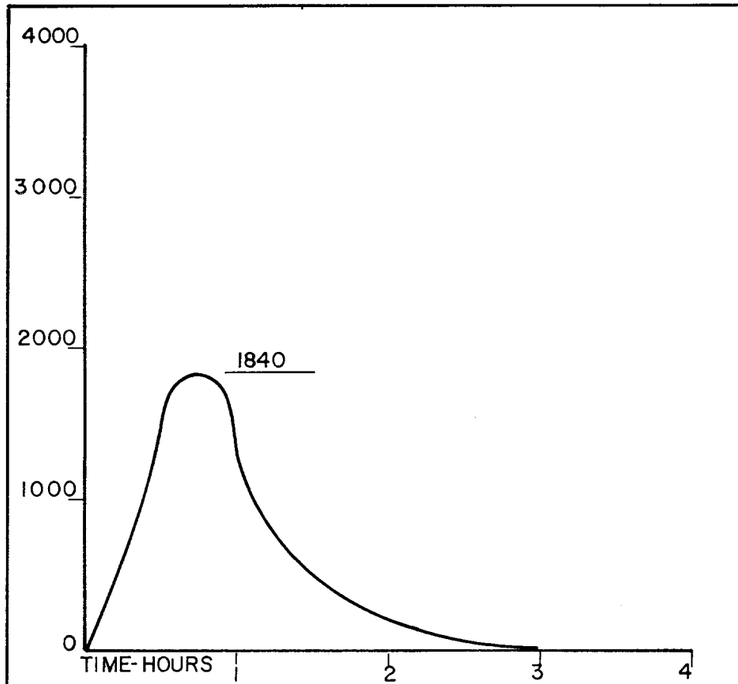


HORIZONTAL SCALE 1" = 2 HOURS

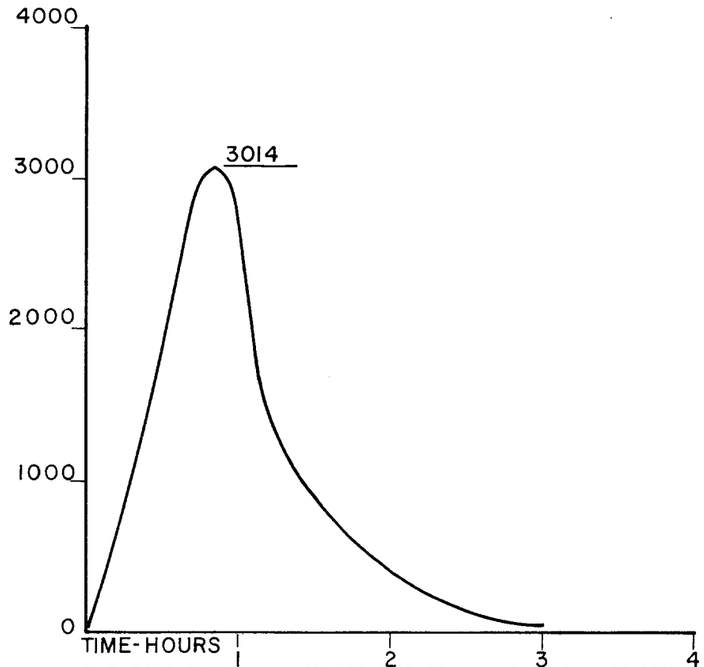
INDIVIDUAL SUB-BASIN HYDROGRAPHS

SAND CREEK DRAINAGE BASIN
CITY OF COLORADO SPRINGS

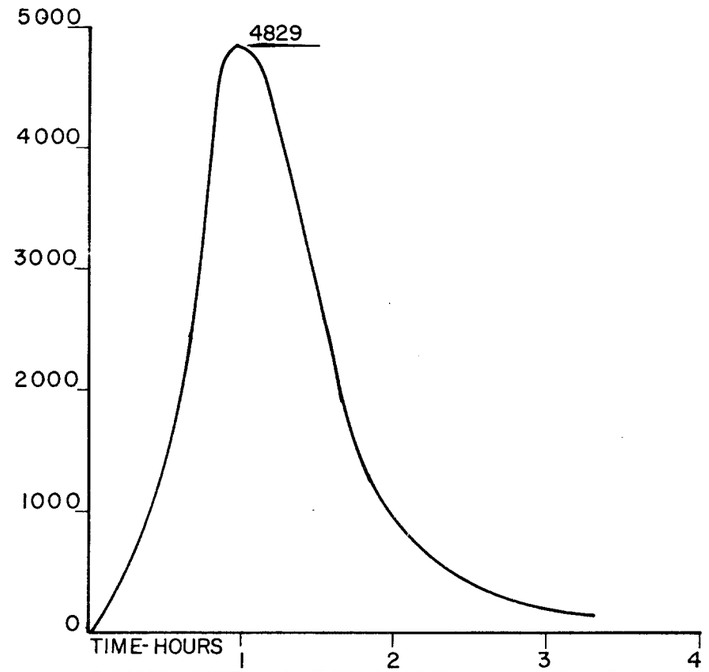
THE LINCOLN DeVORE
TESTING LABORATORY



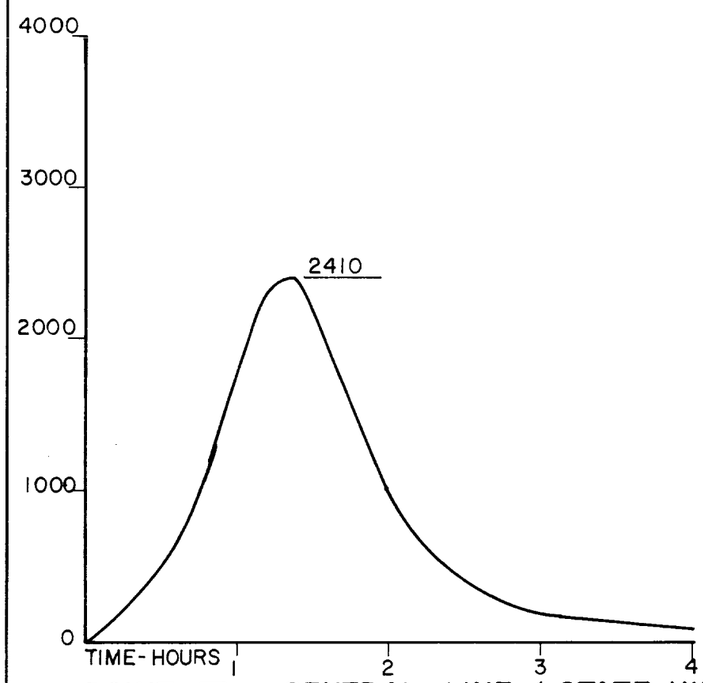
POINT VI – WEST LINE — MAIZELAND RD.



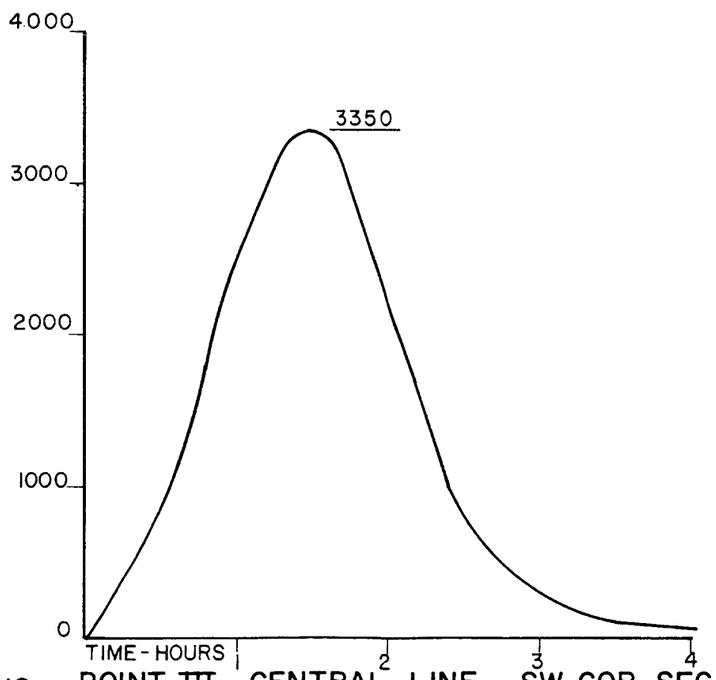
POINT VII — WEST LINE — CONSTITUTION



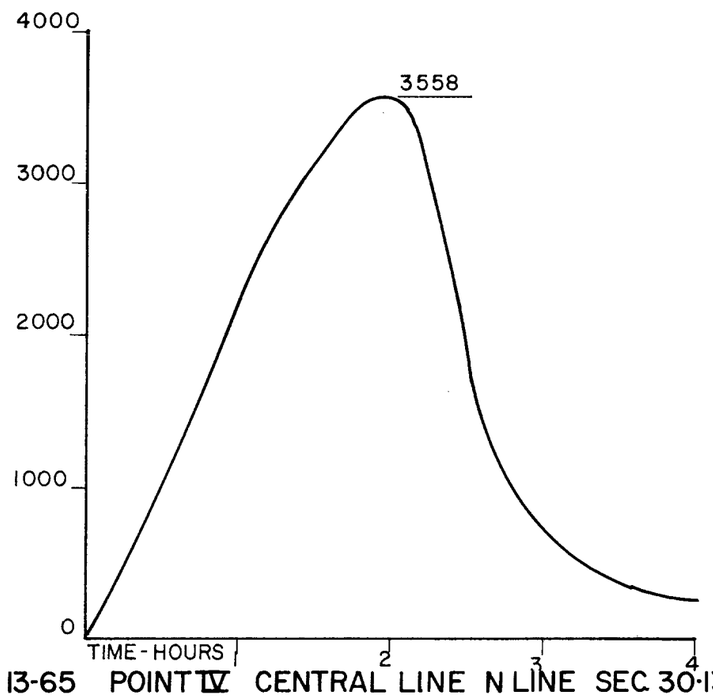
POINT VIII – WEST LINE — U.S. 24



POINT II – CENTRAL LINE – STATE HWY 110

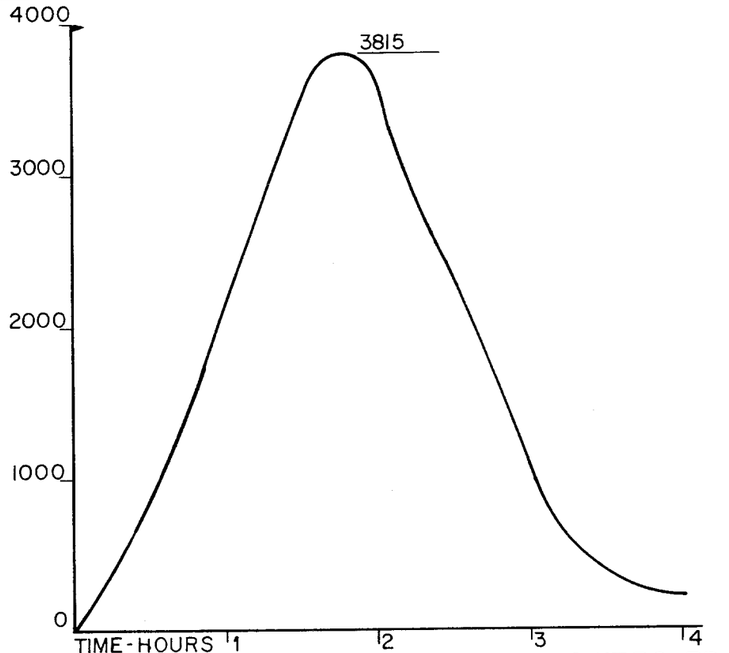


POINT III — CENTRAL LINE — S.W. COR. SEC. 17-13-65

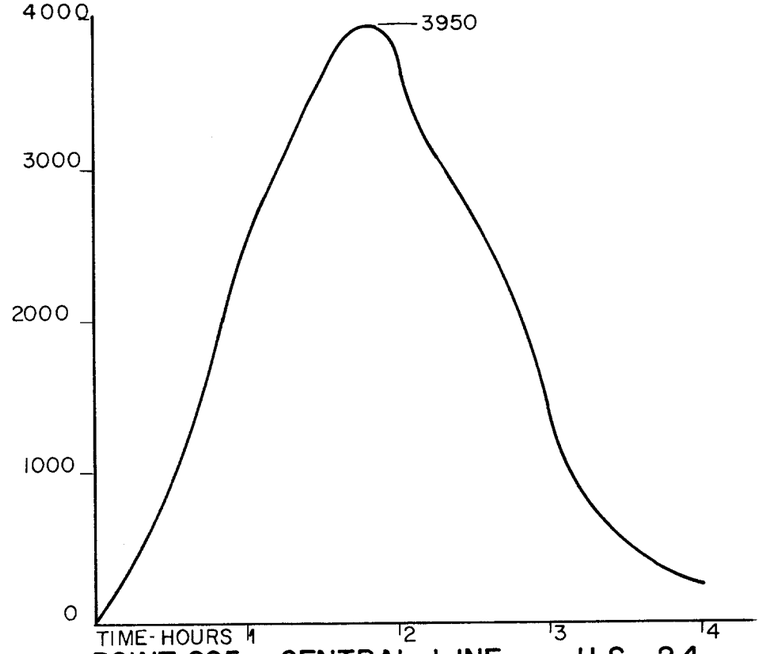


POINT IV CENTRAL LINE N LINE SEC. 30-13-65

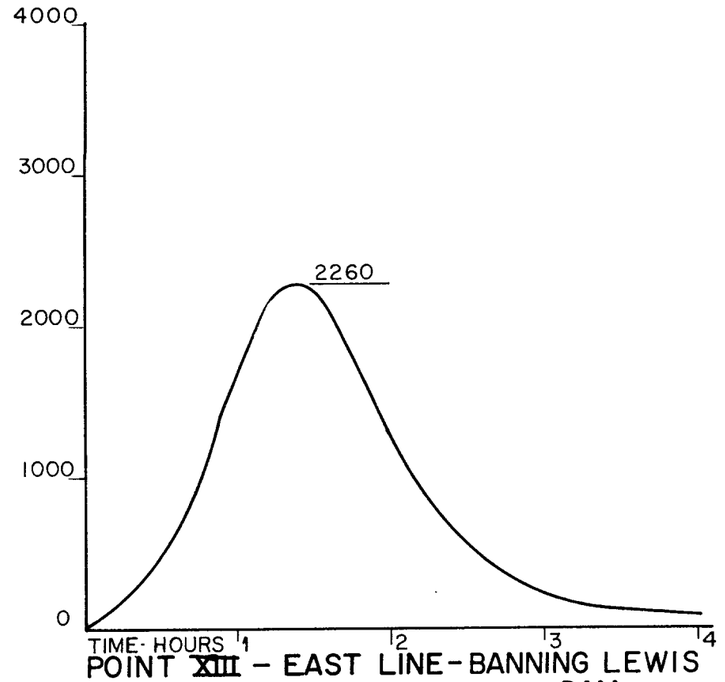
COMBINED GREENBELT HYDROGRAPHS SAND CREEK DRAINAGE BASIN CITY OF COLORADO SPRINGS, COLORADO



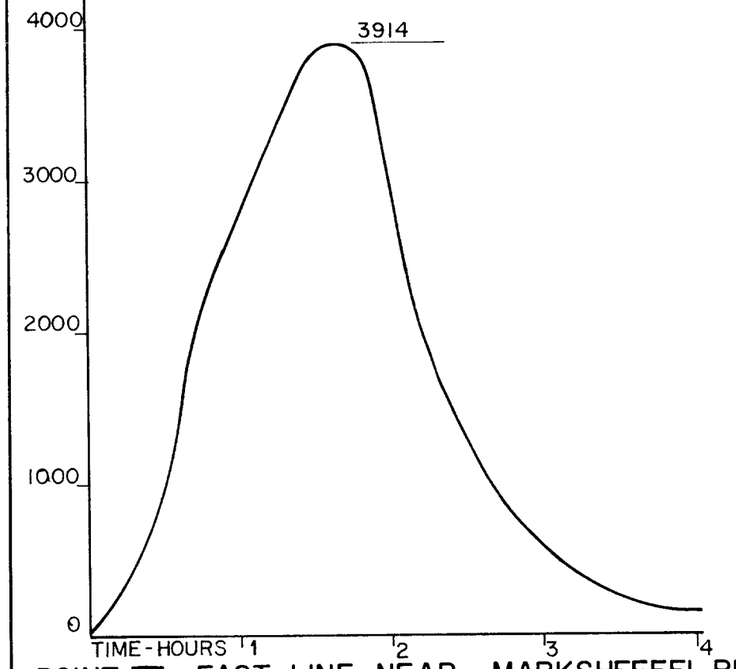
POINT 203— CENTRAL LINE— POWERS RD.



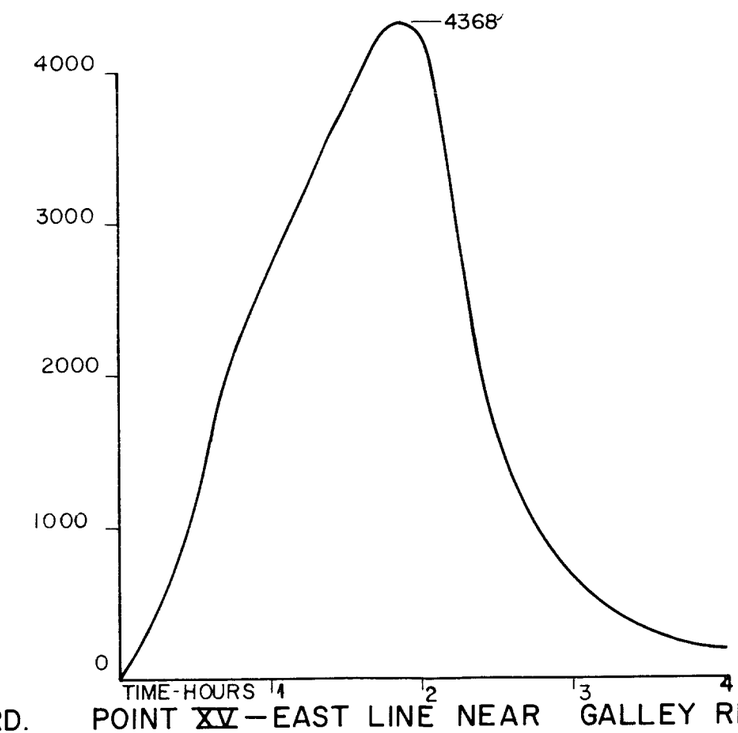
POINT 205— CENTRAL LINE — U.S 24



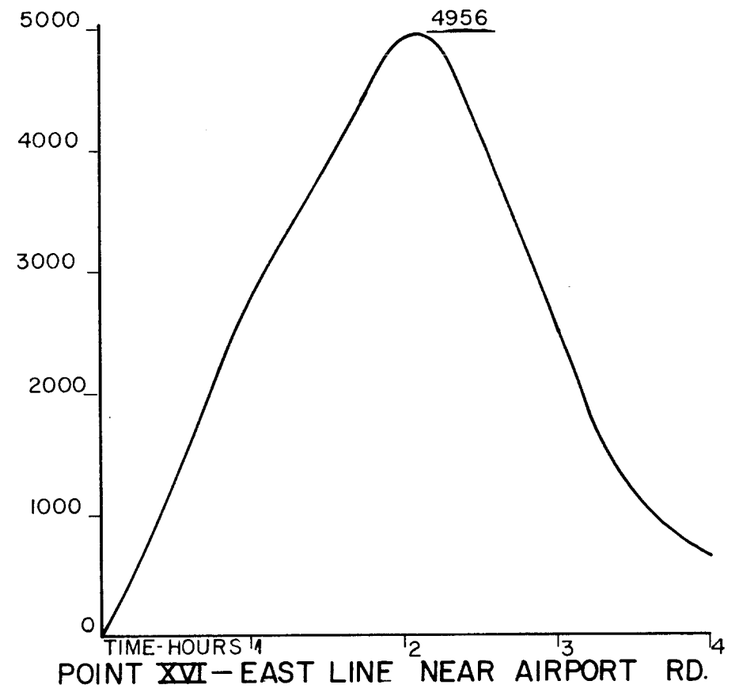
POINT XIII - EAST LINE-BANNING LEWIS DAM



POINT XI—EAST LINE NEAR MARKSHEFFEL RD.

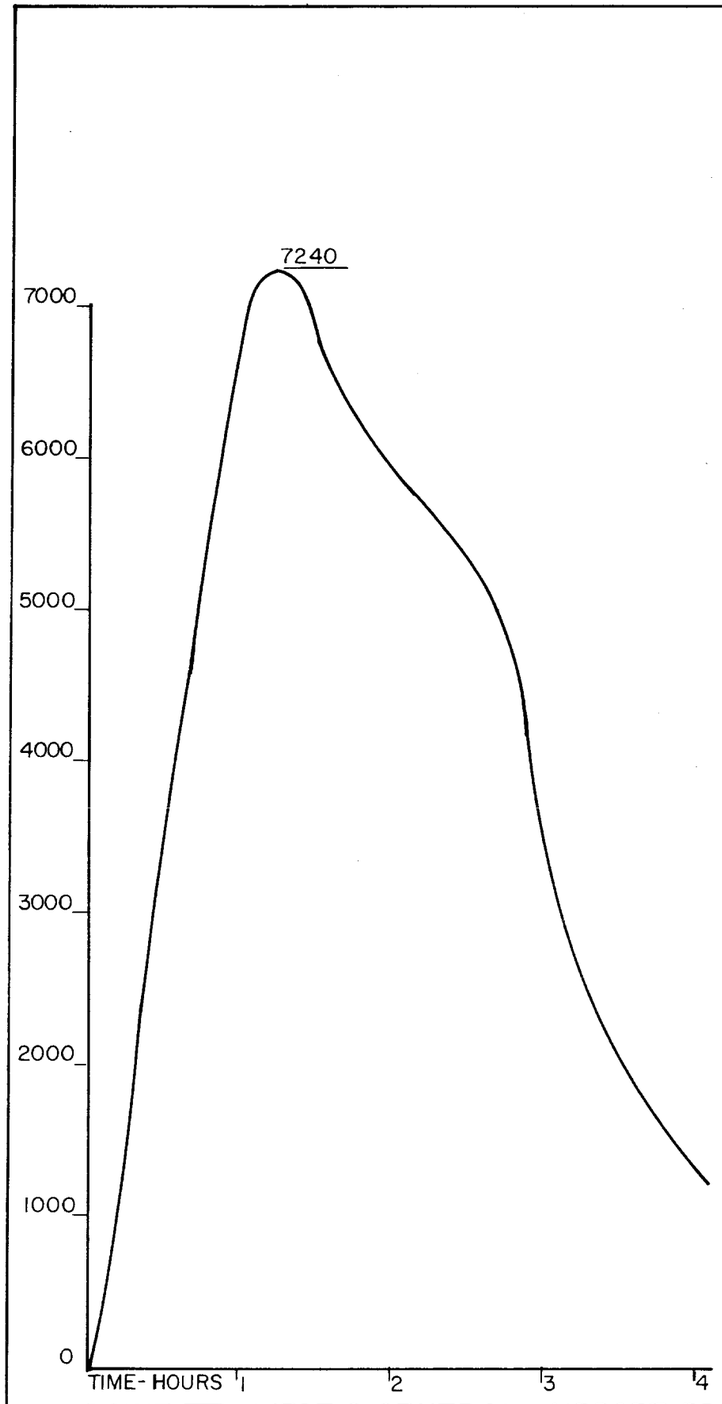


POINT XV—EAST LINE NEAR GALLEY RD.

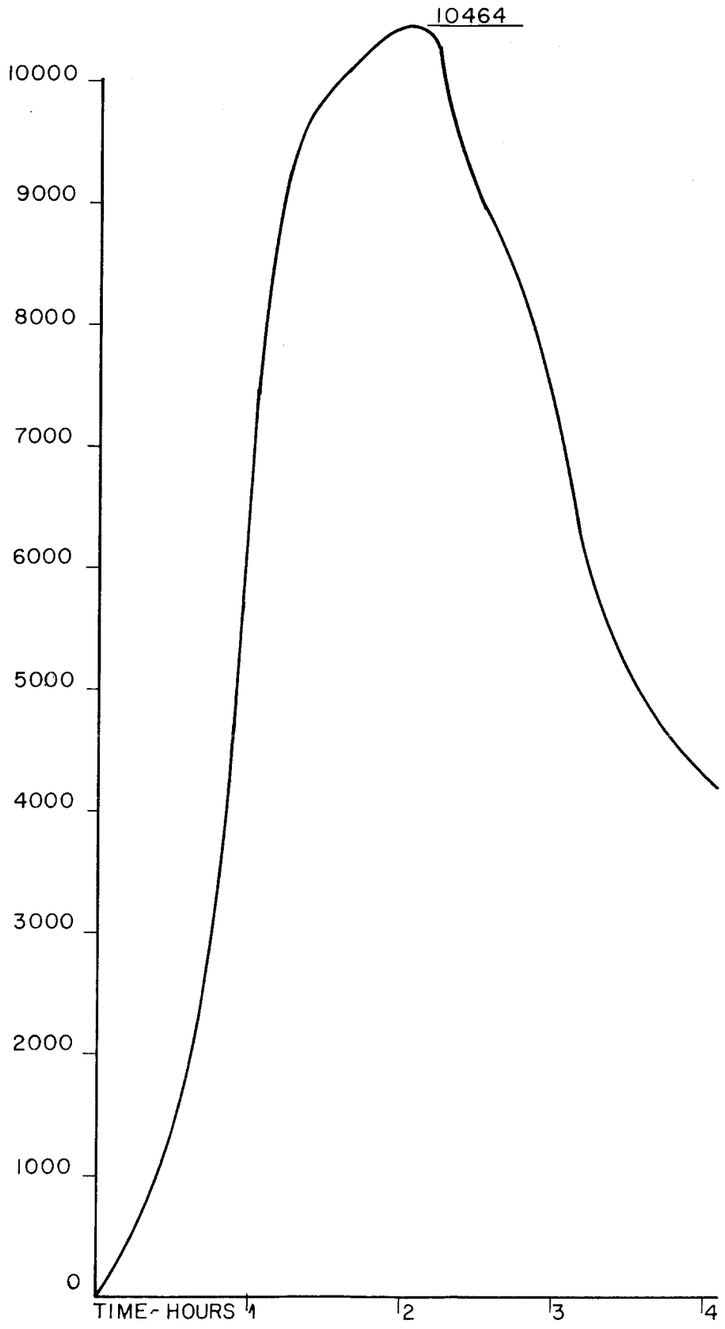


POINT XVI—EAST LINE NEAR AIRPORT RD.

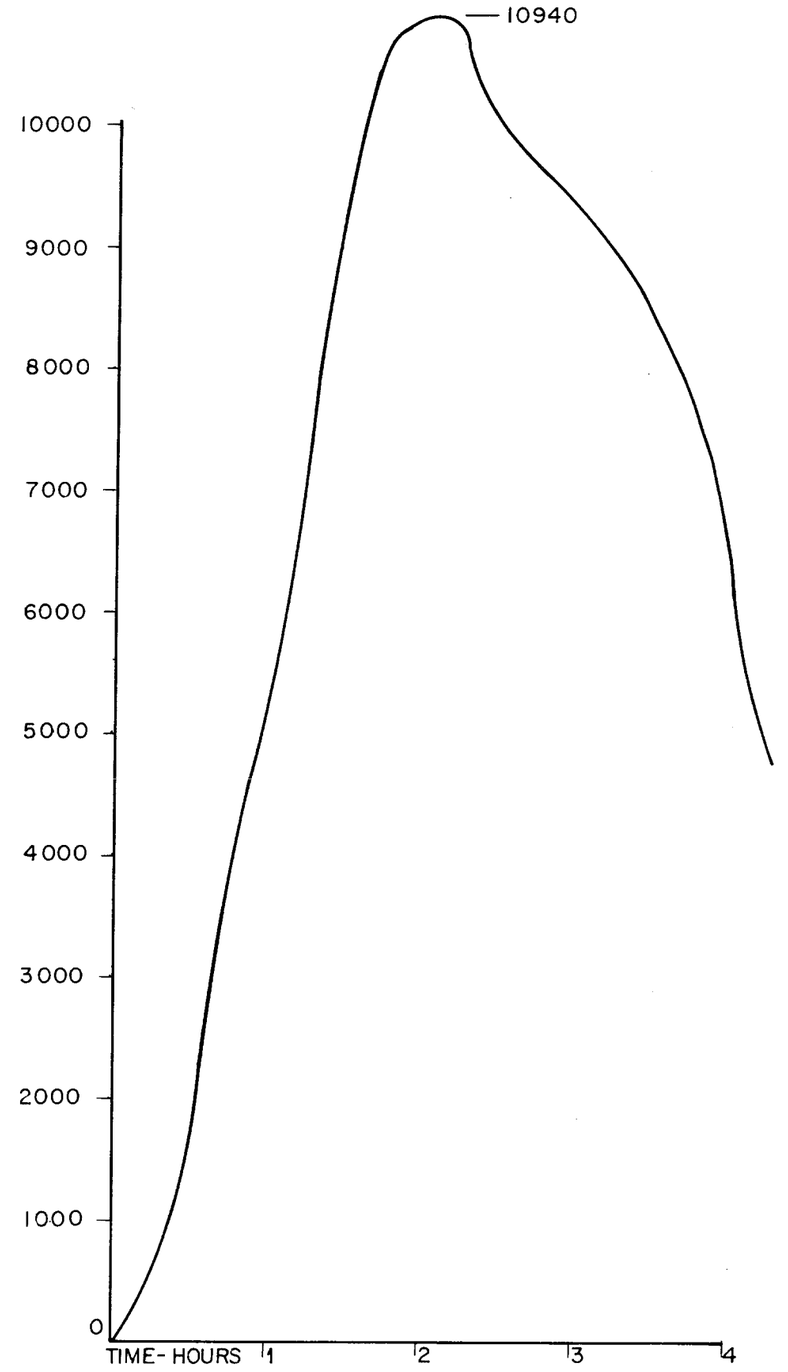
COMBINED GREENBELT HYDROGRAPHS SAND CREEK DRAINAGE BASIN CITY OF COLORADO SPRINGS, COLORADO



POINT IX - WEST & CENTRAL AIRPORT RD.

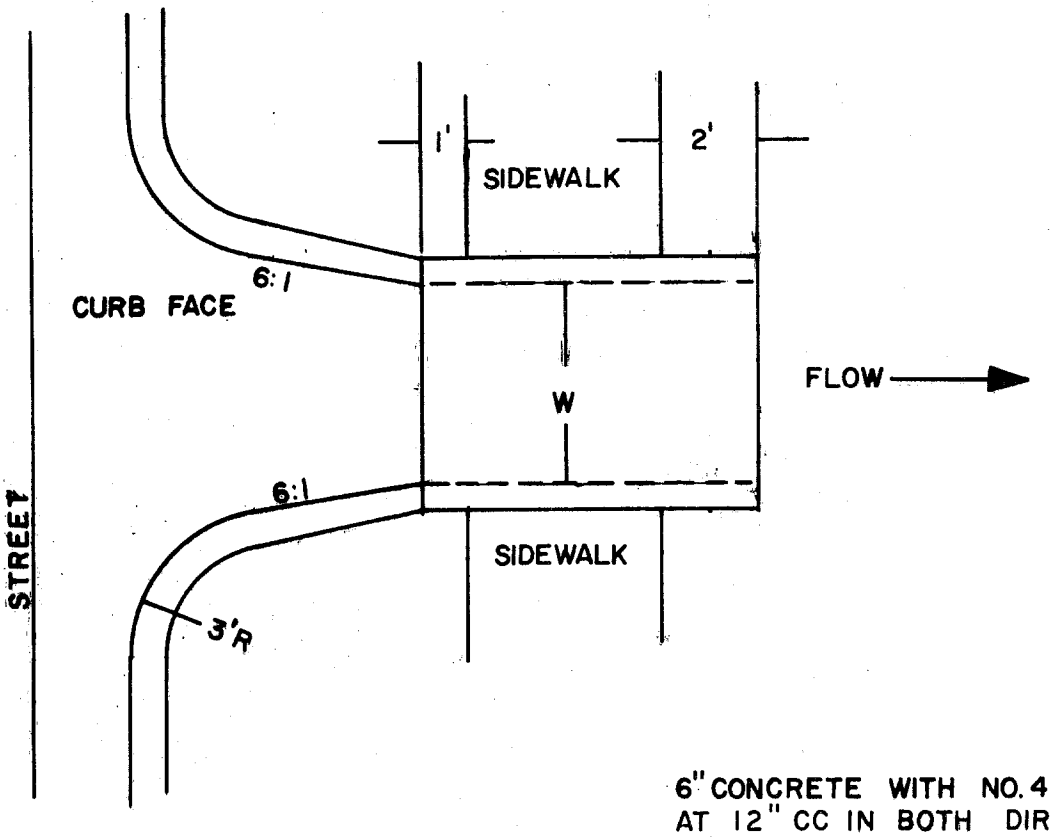


POINT IX A - ALL LINES FOUNTAIN BLVD.

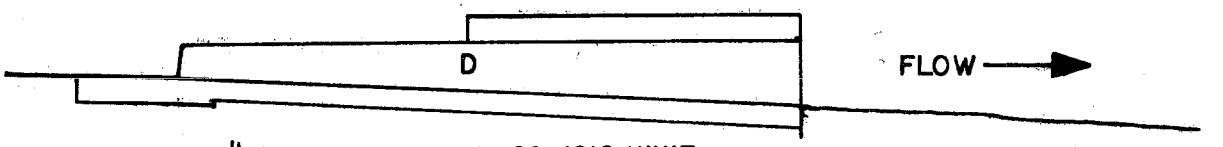


POINT 217 - ALL LINES HANCOCK EXPRESSWAY

COMBINED GREENBELT HYDROGRAPHS SAND CREEK DRAINAGE BASIN CITY OF COLORADO SPRINGS, COLORADO

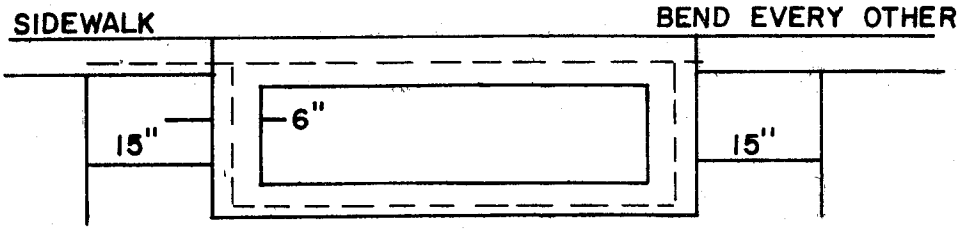


6" CONCRETE WITH NO. 4 BARS
AT 12" CC IN BOTH DIRECTIONS



4" CONCRETE WITH 66-1010 WWF

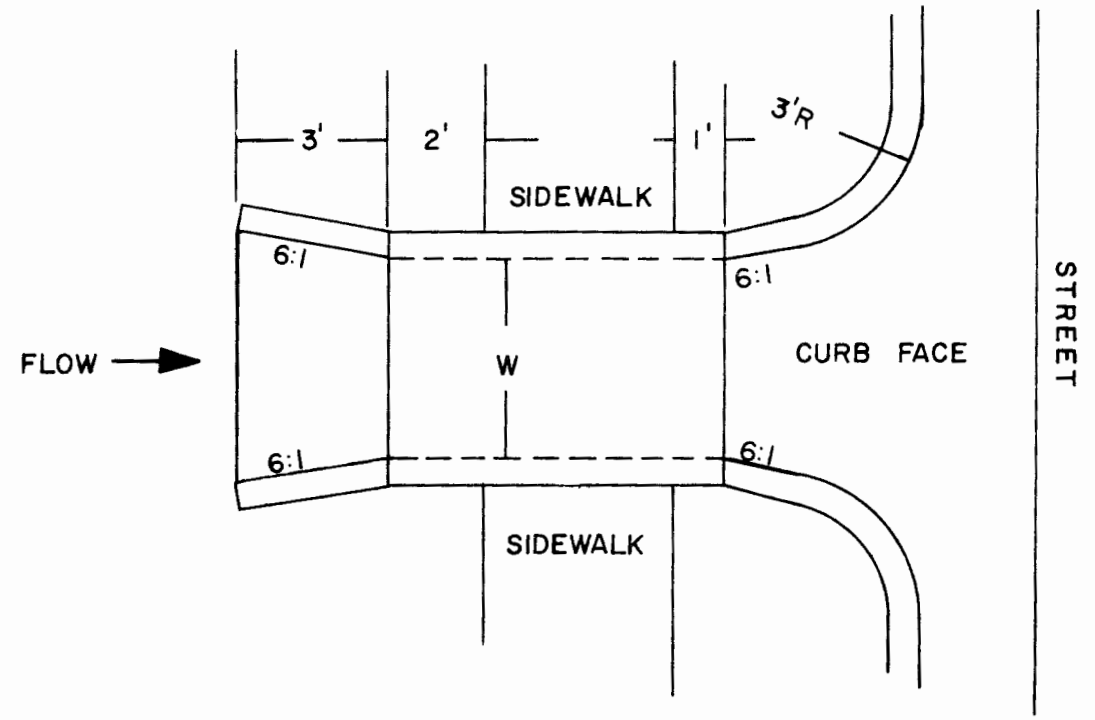
EXTEND EVERY OTHER BAR 15" INTO
SIDEWALK ON BOTH SIDES.
BEND EVERY OTHER BAR INTO WALL



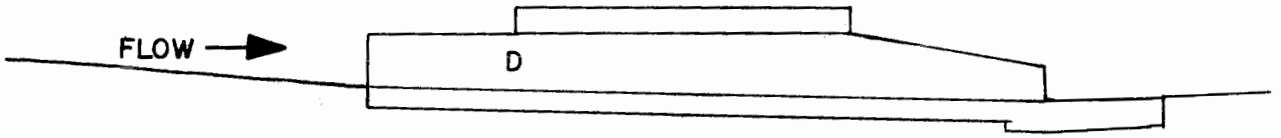
NOTE:
W IS VARIABLE DEPENDING ON QUANTITY OF WATER MINIMUM 4'
D IS VARIABLE DEPENDING ON QUANTITY OF WATER. MINIMUM 1'

CURB INLET

THE LINCOLN DeVORE
TESTING LABORATORY

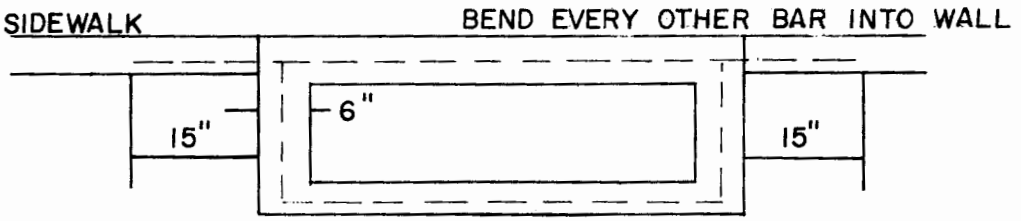


6" CONCRETE WITH NO. 4 BARS
AT 12" CC IN BOTH DIRECTIONS



4" CONCRETE WITH 66-1010 WWF

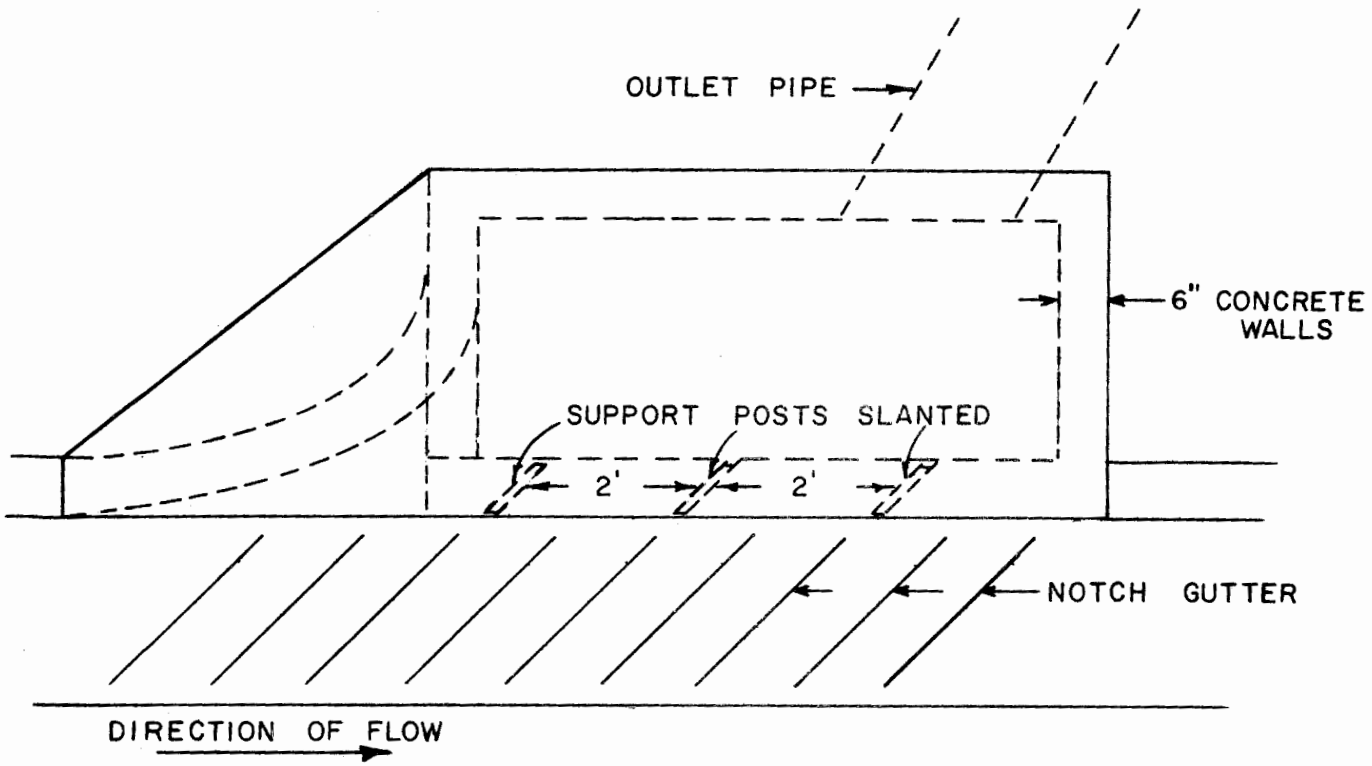
EXTEND EVERY OTHER BAR 15" INTO
SIDEWALK ON BOTH SIDES.
BEND EVERY OTHER BAR INTO WALL

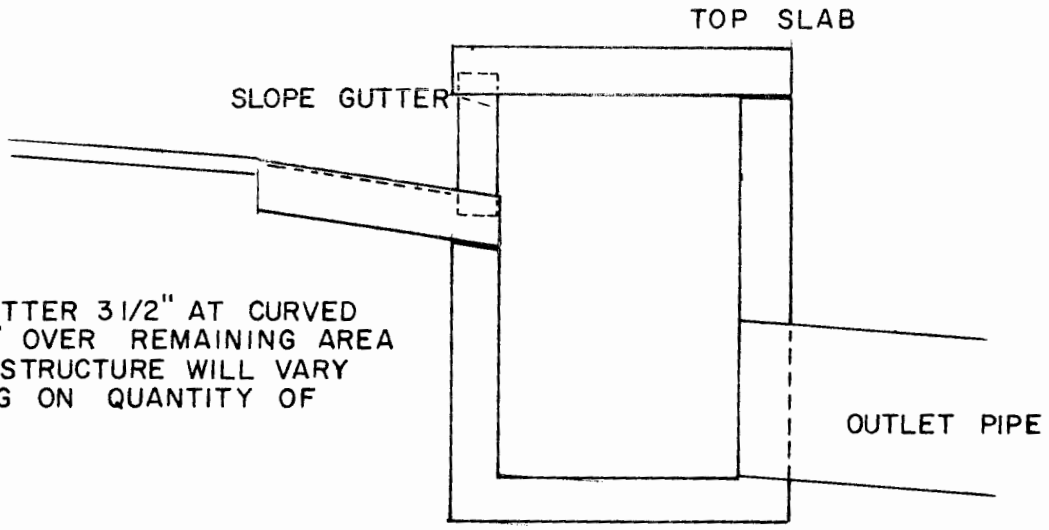


NOTE:
W IS VARIABLE DEPENDING ON QUANTITY OF WATER. MINIMUM 4'
D IS VARIABLE DEPENDING ON QUANTITY OF WATER. MINIMUM 1'

CURB OUTLET

THE LINCOLN DeVORE
TESTING LABORATORY

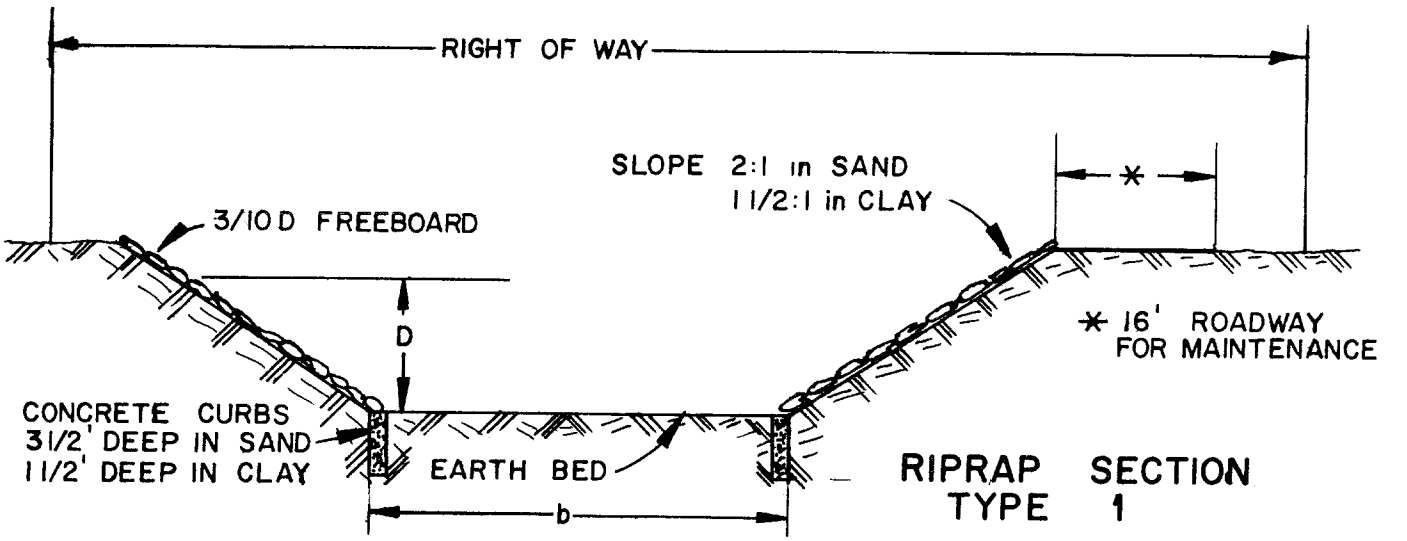




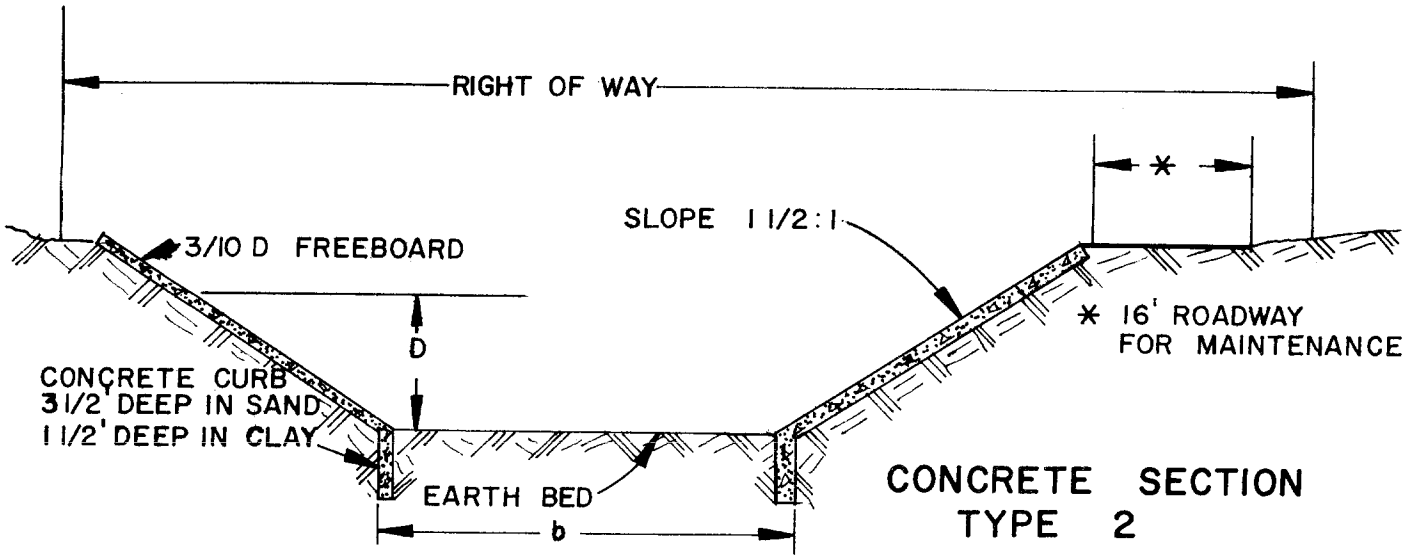
NOTE:
1. SLOPE GUTTER 3 1/2" AT CURVED ENTRY 2" OVER REMAINING AREA
2. SIZE OF STRUCTURE WILL VARY DEPENDING ON QUANTITY OF WATER

HIGH CAPACITY INLET

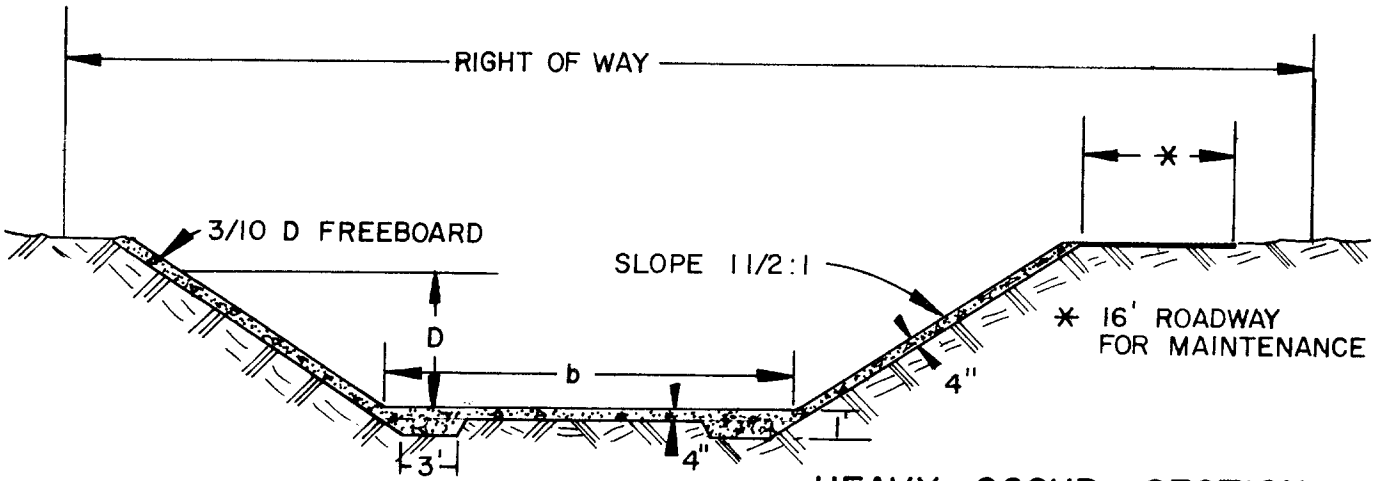
THE LINCOLN DeVORE TESTING LABORATORY



RIPRAP SECTION
TYPE 1



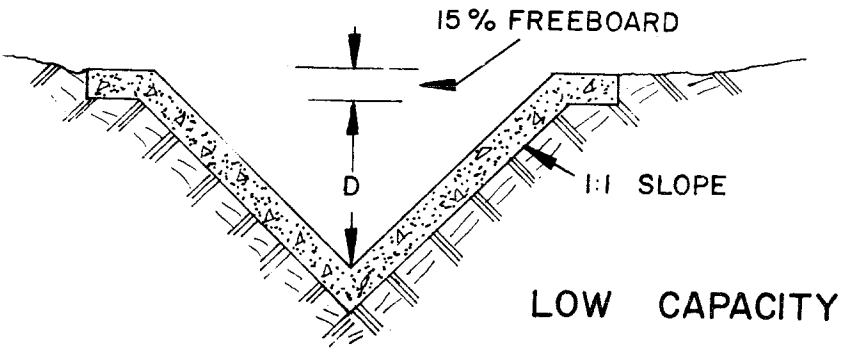
CONCRETE SECTION
TYPE 2



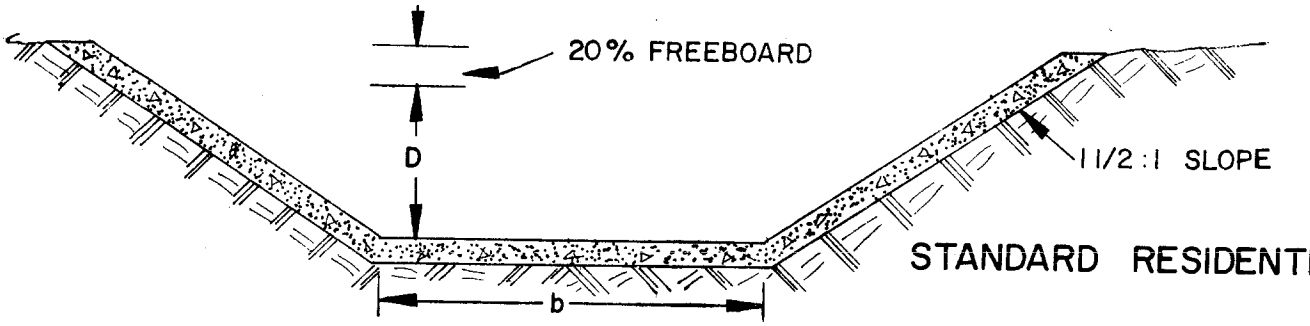
HEAVY SCOUR SECTION
TYPE 3

TYPICAL GREENBELT DITCH SECTIONS

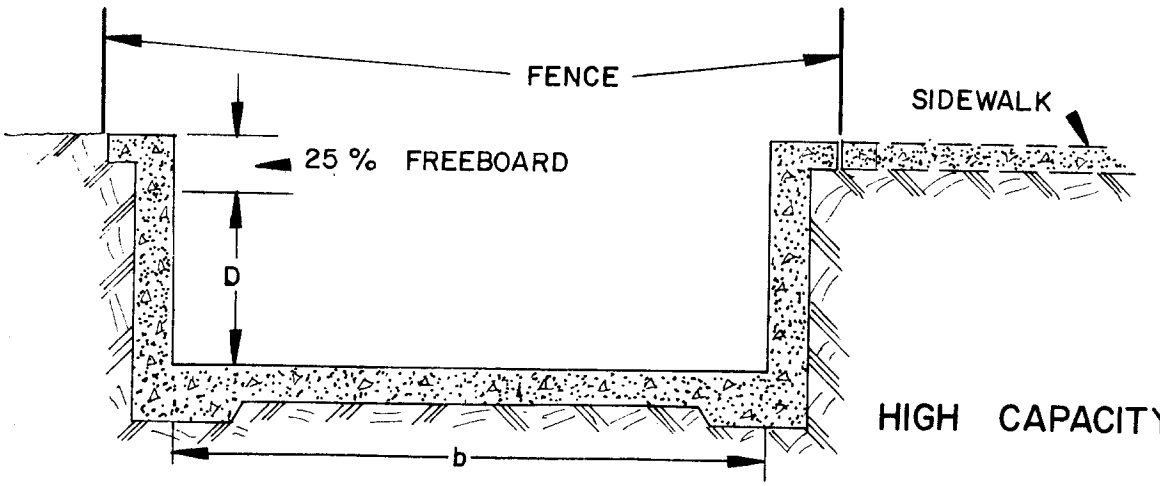
THE LINCOLN DeVORE
TESTING LABORATORY



LOW CAPACITY



STANDARD RESIDENTIAL



HIGH CAPACITY

TYPICAL RESIDENTIAL DITCH SECTIONS

THE LINCOLN DeVORE
TESTING LABORATORY

S U M M A R Y

DRAINAGE DITCHES - GREENBELTS

Table I

POINT FROM	POINT TO	GREENBELTS APPRX. VELOC.	GREENBELTS BOTTOM WIDTH	RECOMMENDED RIGHT OF WAY	MAXIMUM CALC. WATER DEPTH	RECOMMENDED FREEBOARD	RECOMMENDED DITCH TYPE	LENGTH	
Basin 107	Carefree Drive	11.5	30'	60'	2'	1	1	5800	
-	Carefree Drive		30'	60'	2'	1	3	75	
Carefree Drive	Maizeland Road	13.5	38'	60'	3'	1	1	3200	
-	Maizeland Road		38'	60'	3'	1	3	100	
Maizeland Road	Constitution	12.0	79'	100'	3'	1.5	1	2600	
-	Constitution		70'	100'	3'	1.5	3	100	
Constitution	Murray Blvd	13.3	81'	125'	3'	1.5	1 or 2	3600	
Murray Blvd.	Point 211	9.4	93'	125'	4'	2	1	1850	
-	Point 211		79'	120'	4.5'	2.5	3	200	
Basin 89	Point 212	13.1	20'	50'	2'	1	1	1700	
Point 212	Palmer Park	12.7	33'	60'	2'	1	1 or 2	2000	
Palmer Park	Point 211	9.9	38'	70'	2.5'	1	1 or 2	4300	
Point 211	U.S.24	12.4	79'	120'	4.5'	2.5	1	1900	
-	U.S. 24		79'	120'	4.5'	2.5	3	100	
U.S. 24	Point VIIIA	12.6	73'	110'	5'	2.5	2	3650	

S U M M A R Y

DRAINAGE DITCHES - GREENBELTS

Table I

POINT FROM	POINT TO	GREENBELTS APPRX. VELOC.	GREENBELTS BOTTOM WIDTH	RECOM-MENDED RIGHT OF WAY	MAXIMUM CALC. WATER DEPTH	RECOM-MENDED FREE BOARD	RECOM-MENDED DITCH TYPE	LENGTH	
-	Point VIIIA		73'	110'	5'	2.5	3	50	
Point IV	Point 201	12.2	62'	100'	4.5'	2.0	1	2700	
-	Point 201		62'	100'	4.5'	2.0	3	225	
Point 201	Point 202	12.4	62'	100'	4.5'	2.0	1	4250	
-	Point 202		62'	100'	4.5'	2.0	3	150	
Point 202	Powers Road	12.8	62'	100'	4.5'	2.0	1	3350	
-	Powers Road		62'	100'	4.5'	2.0	3	150	
Powers Road	Galley Road	12.8	62'	100'	4.5'	2.0	1	5450	
-	Galley Road		62'	100'	4.5'	2.0	3	150	
Galley Road	U. S. 24	12.8	70'	125'	4.5'	2.0	1	2900	
U.S. 24	Point VIIIA	12.9	70'	125'	4'	1.5	1	2750	
-	Point VIIIA		96'	140'	4.5'	2.0	3	250	
Point VIIIA	Point IX	13.9	96'	140'	4.5'	2.0	1	3500	
-	Point IX		96'	140'	4.5'	2.0	3	200	
Point IX	Point 214	13.8	97'	140'	4.5'	2.0	1	4100	

S U M M A R Y
DRAINAGE DITCHES - GREENBELTS

Table I

POINT FROM	TO	GREENBELTS APPRX. VELOC.	BOTTOM WIDTH	RECOM-MENDED RIGHT OF WAY	MAXIMUM CALC. WATER DEPTH	RECOM-MENDED FREE-BOARD	RECOM-MENDED DITCH TYPE	LENGTH	
-	Point 214		97'	140'	4.5	2.0	3	200	
Basin 34	Point XI	12.9	55'	100'	3.5'	1.5	1	5800	
-	Point XI		55'	100'	3.5'	1.5	3	350	
Basin 68	Point XI	12.7	40'	80'	3.0'	1.0	1	9400	
-	Point XI		40'	80'	3.0'	1.0	3	100	
Point XI	Mark-sheffel	13.2	60'	100'	4.5'	1.5	1 or 2	2880	
-	Mark-sheffel		60'	100'	4.5'	1.5	3	490	
Basin 94	Point XIV	11.4	30'	50'	4	1.5	1	4700	
Point XIV	Mark-sheffel	11.9	40'	60'	4	1.5	1	3350	
-	Mark sheffel		40'	60'	4	1.5	1	50	
Mark-sheffel	Palmer Park	13.2	40'	60'	4	2	1 or 2	860	
-	Palmer Park		40'	60'	4	2	3	150	
Palmer Park	Point XV	13.4	64'	100'	4.5	2	1	4650	

S U M M A R Y
DRAINAGE DITCHES - GREENBELTS
Table I

POINT FROM	POINT TO	GREENBELTS APPRX. VELOC.	GREENBELTS BOTTOM WIDTH	RECOM-MENDED RIGHT OF WAY	MAXIMUM CALC. WATER DEPTH	RECOM-MENDED FREE-BOARD	RECOM-MENDED DITCH TYPE	LENGTH
-	Point XV		64'	100'	4.5'	2	3	150
Basin 45	Western Drive	9.9	18'	30'	2.5'	1	1	3800
Western Drive	Palmer Park	10.8	24'	50'	3'	1	1	2950
Palmer Park	Point XV	11.3	40'	60'	4'	1.5	1	3350
-	Point XV		40'	60'	4'	1.5	3	50
Point XV	Galley Road	14.2	64'	100'	4.5'	2	1	1050
-	Galley Road		64'	100'	4.5'	2	3	1000
Galley Road	U. S. 24	14.2	64'	100'	4.5'	2.5	1	2550
-	U. S. 24		64'	100'	4.5'	2.5	3	250
U.S. 24	Powers Road	14.2	70'	125'	4.5'	2	1	6600
-	Powers Road		70'	125'	4.5'	2	3	250
Powers Road	Point XVI	14.2	70'	125'	4.5'	2	1 or 2	3200
-	Point XVI		70'	125'	4.5'	2	3	375

S U M M A R Y
DRAINAGE DITCHES - GREENBELTS

Table I

POINT FROM	POINT TO	GREENBELTS APPRX. VELOC.	GREENBELTS BOTTOM WIDTH	RECOM-MENDED RIGHT OF WAY	MAXIMUM CALC. WATER DEPTH	RECOM-MENDED FREE-BOARD	RECOM-MENDED DITCH TYPE	LENGTH
Basin 97	Galley Road	12.6	20'	50'	3	1	1	3000
-	Galley Road		20'	50'	3	1	3	25
Galley Road	U.S. 24	12.6	22'	55'	3	1.5	1	2550
-	U. S. 24		22'	55'	3	2	3	200
U.S. 24	Powers Road	10.0	22'	55'	3	1.5	1	1650
-	Powers Road		22'	55'	3	1.5	3	200
Powers Road	Airport Road	10.0	44'	75'	3	2	1 or 2	4600
-	Airport Road		44'	75'	3	2	3	150
Airport Road	Point XVI	10.1	44'	75'	3	2	1 or 2	950
-	Point XVI		44'	75'	3	2	3	100
Point XVI	Point 214	13.4	76'	125'	4.5		1 or 2	5050
-	Point 214		76'	125'	4.5		3	400
Point 214	Fountain Blvd	14.2	155'	200'	4.5		3	100
-	Fountain Blvd		155'	200'	4.5		3	200

S U M M A R Y
DRAINAGE DITCHES - GREENBELTS

Table I

POINT		GREENBELTS		RECOM-MENDED	MAXIMUM CALC.	RECOM-MENDED	RECOM-MENDED	LENGTH	
FROM	TO	APPRX. VELOC.	BOTTOM WIDTH	RIGHT OF WAY	WATER DEPTH	FREE-BOARD	DITCH TYPE		
Fountain Blvd	Academy Blvd	14.4	155'	200'	4.5'		1 or 2	3950	
-	Academy Blvd		155'	200'	4.5'		3	300	
Basin 132	Monterey Street	11.6	33'	64'	3'		1 or 2	4000	
Academy Blvd	Hancock Street	14.4	155'	200'	4.5'		1 or 2	3100	
-	Hancock Street		155'	200'	4.5'		3	300	
Hancock Street	Point XVII	14.6	140'	200'	5		1 or 2	2450	
Point XVII	Point XVIII	14.7	156'	200'	5		2	5200	

S U M M A R Y
DRAINAGE DITCHES - LOCAL
Table 2

BASIN NO.	WATER WIDTH	WATER DEPTH	LENGTH
109	6'	2'	200'
110	6'	3'	250'
113	6'	3'	150'
114	8'	2'	2000'
114	4'	2'	1400'
115	2'	2'	900'
115	3'	2'	600'
117	4'	1'	100'
117	4'	1'	100'
117	4'	1'	100'
118	5'	1.5'	400'
118	3'	1'	150'
118	10'	2'	950'
119	10'	2'	750'
119	4'	2'	500'
120	4'	2'	1800'
123	6'	2'	150'
123	3'	3'	150'

NOTES: All ditches paved as shown on detail sheet.
Existing ditches: 3 in Basin 118, 2'x 4' in Basin 120, 2'x 6' in Basin 123, 3'x 3' in Basin 123, 3'x 8' in Basin 124.

S U M M A R Y
DRAINAGE DITCHES - LOCAL
Table 2

BASIN NO.	WATER WIDTH	WATER DEPTH	LENGTH
124	8'	3'	100'
124	5'	2'	100'
124	3'	2'	100'
124	10'	3'	200'
87	10'	2'	500'
87	15'	2'	500'
87	15'	3'	500'
87	20'	3'	850'
87	16'	2'	1800'
88	6'	2'	400'
88	20'	4'	800'
102	2'	2'	350'
102	3'	2'	300'
102	5'	2'	100'
104	4'	2'	100'
83	8'	3'	850'

NOTES: All ditches paved as shown on detail sheet.
Existing ditches: 3 in Basin 118, 2'x4' in Basin 120, 2'x6' in Basin 123, 3' x 3' in Basin 123, 3'x 8' in Basin 124.

S U M M A R Y
DRAINAGE DITCHES - LOCAL
Table 2

BASIN NO.	WATER WIDTH	WATER DEPTH	LENGTH
93	10'	3'	200'
93	10'	2'	1100'
92	8'	2'	150'
92	3'	2'	150'
91	4'	2'	150'
91	8'	2'	300'
91	3'	2'	400'
91	2'	2'	1000'
91	6'	2'	1200'
84	6'	2'	600'
82	6'	2'	800'
90	16'	2'	700'
90	12'	3'	750'
90	6'	2'	150'
101	5'	2'	150'
101	3'	2'	200'
101	2'	2'	300'
101	3'	2'	200'

NOTES: All ditches paved as shown on detail sheet.
Existing ditches: 3 in Basin 118, 2'x 4' in Basin 120, 2'x 6' in Basin 123, 3'x 3' in Basin 123, 3'x 8' in Basin 124.

S U M M A R Y

DRAINAGE DITCHES - LOCAL

Table 2

BASIN NO.	WATER		
	WIDTH	DEPTH	LENGTH
101	4'	2'	150'
101	5'	2'	100'
101	4'	2'	150'
126	7'	2.5'	400'
130	4'	2'	350'
34	6'	2'	400'
39	5'	2'	200'
40	5'	2'	950'
40	7'	2'	1100'
40	10'	3'	3000'
94	25'	2.5'	2600'
94	4'	2'	800'
94	8'	2'	950'
42	8'	2.5'	1800'
44	5'	2'	300'

NOTES: All ditches paved as shown on detail sheet.
Existing ditches: 3 in Basin 118, 2'x 4' in Basin 120, 2'x 6' in Basin 123, 3'x 3' in Basin 123, 3'x 8' in Basin 124.

S U M M A R Y
DRAINAGE DITCHES - LOCAL

Table 2

BASIN NO.	WATER WIDTH	WATER DEPTH	LENGTH
45	3'	2'	400'
45	4'	2'	400'
46	3'	2'	1000'
46	5'	2.5'	800'
97	3'	2'	150'
47	6'	2.5'	800'
127	4'	2'	150'
128	10'	1.5'	2300'
129	3'	2'	300'
129	5'	2.5'	400'
129	10'	2'	900'
132	5'	2'	1600'
132	6'	2.5'	2000'
133	5'	2'	200'
133	5'	2.5'	400'
136	6'	2.5'	1650'

NOTES: All ditches paved as shown on detail sheet.
Existing ditches: 3 in Basin 118, 2'x 4' in Basin 120, 2'x 6' in Basin 123, 3'x 3' in Basin 123, 3'x 8' in Basin 124.

S U M M A R Y
DRAINAGE DITCHES - LOCAL

Table 2

BASIN NO.	WATER WIDTH	WATER DEPTH	LENGTH
137	4'	2.5'	450'
137	6'	3'	2100'
137	3'	2'	900'
137	4'	2'	350'
138	6'	2'	1600'

NOTES: All ditches paved as shown on detail sheet.
Existing ditches: 3 in Basin 118, 2'x 4' in Basin 120, 2'x 6' in Basin 123, 3'x 3' in Basin 123, 3'x 8' in Basin 124.

S U M M A R Y
STORM SEWERS - DEVELOPED SYSTEM

Table 3

BASIN	LOCATION	PIPE DIAMETER (inches)	LENGTH	INLETS
110	Unnamed Street	30	400'	4-1x
	Spring Valley	36	700'	2-2x
		42	400'	2-2x
		48	1100'	4-2x
		54	320'	2-1x
		66	340'	1-1x 1-2x
112	Carefree Circle	30	200'	3-1x
		36	500'	3-2x
		42	300'	1-1x
		48	550'	2-2x
		60	240'	1-2x
		66	180'	1-2x
113	Maizeland Road Extension	36	800'	3-2x
		48	750'	3-2x
120/121 122	Constitution & Brady	36	1150'	6-2x
		42	1000'	3-1x
		54	700'	2-2x
123	LaSalle Extension	36	400'	2-2x
		48	400'	2-2x
123	Keaton Lane	42	580'	2-2x
124/123	Fetterman Drive	36	700'	4-2x
		42	250'	2-2x
		48	1000'	4-2x
		66	300'	3-2x

S U M M A R Y
STORM SEWERS - DEVELOPED SYSTEM
Table 3

BASIN	LOCATION	PIPE DIAMETER (inches)	LENGTH	INLETS
86/87	Bent Bar Road & Brady	36	500'	2-2x
		48	300'	4-2x
		54	440'	1-1x
104	Wooten Road & Osgood	30	400'	4-2x
		42	320'	1-1x
104	Geiger & Wooten	36	640'	2-2x
		48	430'	2-2x
		54	600'	3-2x
		60	480'	1-3x
		72	600'	2-2x
83/84	Carefree Extension near Powers Drive	36	900'	4-2x
		42	720'	5-1x
		48	1300'	2-2x
		54	850'	2-2x
		66	800'	2-2x
		72	800'	1-4x
82	Unnamed Street near Constitution	30	550'	3-2x
		42	480'	1-1x
		48	600'	2-1x
92	Carefree Extension	36	500'	2-2x
		42	440'	2-1x
90	Palmer Park Boulevard near Powers	36	840'	4-2x
		48	540'	4-2x

S U M M A R Y
STORM SEWERS - DEVELOPED SYSTEM

Table 3

BASIN	LOCATION	PIPE DIAMETER (inches)	LENGTH	INLETS
46	Unnamed Street near Western & Palmer Park Blvd.	30	700'	2-2x
		36	600'	3-1x
		48	500'	1-3x
47	Unnamed Street near Galley & U S 24	36	500'	1-1x
		48	440'	3-2x
97	Palmer Park Boulevard near Chippewa	30	280'	4-1x
		36	520'	2-2x
		42	400'	2-1x
		48	380	3-2x
		54	500'	1-1x
99	Paonia near Palmer Park Boulevard	36	500'	3-2x
		42	570'	2-1x
		48	600'	1-2x
106	Central, Paonia to Ford	36	800'	4-1x
		48	900'	4-2x
127	Unnamed Street near Pikes Peak & Powers	36	550'	1-3x 1-1x
		48	580'	1-2x
129	Unnamed Street north of Powers & Fountain	42	750'	2-2x
		48	500'	3-1x
		54	500'	3-2x
		60	380'	2-2x
		72	250'	
131	Fountain Boulevard near Powers	36	450'	4-1x

S U M M A R Y
STORM SEWERS - DEVELOPED SYSTEM
Table 3

BASIN	LOCATION	PIPE DIAMETER (inches)	LENGTH	INLETS
131(con't	Fountain Boulevard near Powers)	42	840'	4-2x
		48	900'	2-1x
134	Delta near Chelton Road	30	430'	6-1x
		36	900'	3-2x
		48	680'	3-2x
		54	960'	3-2x
		66	300'	
135	Monterey - Capulin to Granada	30	140'	7-1x
		36	960'	3-2x
		42	820'	5-1x
		48	600'	4-2x
		54	240'	2-2x
		60	510'	1-3x
		84	800'	
136	Unnamed Road near Academy & Hancock	36	400'	2-1x
		48	600'	5-2x
		54	620'	1-3x
		66	540'	

S U M M A R Y
MAJOR STRUCTURES ON GREENBELT

Table 4

LOCATION	EXISTING FACILITY	REQUIRED FACILITY
Carefree Circle near Murray	none	90□' opening with 2 dropouts
Maizeland Road near Wold	none	130□'opening with 2 dropouts
Valley Vista at Wold	Small dropout	Special street dropout
Constitution near Wold	2 - 66" CMP	250□' opening
Palmer Park Blvd. near Potter	5 - 3 x 10 Box	Add 3-3 x 10 Box
Murray near Moffatt	2-4 x 8 Box	Add 4-4 x 9 Box
Galley near Moffatt	5-4 x 10 Box	Add 4-4 x 10 Box
US 24 @ VIII	2-4 x 6 Box	Add 332□'Opening
Van Diest near Wooten	none	54"ØCMP 1 Dropout
Darley near Wooten	none	60"ØCMP 1 Dropout
Wooten near Darley	none	48"ØCMP 1 Dropout
Robidoux near Wooten	none	58□'Opening 2 Dropout
Palmer Park near Wooten	2-4 x 9 Box	No additional
Galley @ Wooten	3-4 x 9 Box	No additional
Wooten near Pikes Peak	none	420□'Opening 3 Dropout
Carefree in Basin 92	none	340□'Opening 2 Dropout
CRI & PRR in Basin 91		320□'Opening

S U M M A R Y
MAJOR STRUCTURES ON GREENBELT

Table 4

LOCATION	EXISTING FACILITY	REQUIRED FACILITY
Powers near Palmer Park	none	320□' Opening 2 Dropout
Galley near Branding Iron	none	330□' Opening 2 Dropout
US 24 near Babcock	Bridge	No additional
Airport near Miller	none	670□'Opening 2 Dropout
Marksheffel Drive near Akers	none	84"Ø CMP
Marksheffel Drive near Palmer Park	2 - 36" CMP	300□' Opening 2 Dropout
Palmer Park near Marksheffel Drive	none	320□' Opening 2 Dropouts
Western in Basin 45	none	48" CMP
Palmer Park near Western	none	54" CMP
Galley near Western	none	330□'Opening 2 Dropout
Galley near Paonia	none	65□'Opening 1 Dropout
US 24 near Hathaway	Bridge	No additional
US 24 near Powers	4 x 4 Box	90□' Opening
Powers near US 24	none	110□' Opening 2 Dropout
Powers @ Airport	none	380□' Opening 2 Dropout
Airport near Powers	2-26 x 44 CMP	155□' Opening 2 Dropout

S U M M A R Y

MAJOR STRUCTURES ON GREENBELT

Table 4

LOCATION	EXISTING FACILITY	REQUIRED FACILITY
Fountain near Chapman	1 - 24" CMP 2 - 48" CMP	800□' Opening 2 Dropout
Fountain in Basin 131	none	Special Street Dropout
Academy @ Chelton	48"Ø CMP 1 - 24"Ø CMP	72" Ø CMP 1 Dropout
Academy south of Chelton	1 - 84" Ø CMP	850□' Opening 3 Dropout
Hancock near Granada	2 - 30" Ø CMP	900□'Opening 2 Dropout
AT & SF RR	Bridge	No Additional
D & RGW RR	Bridge	No Additional
Las Vegas Cutoff	Road Dip	leave dip or add 940□' Opening